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The New Loch Raven Dam at Baltimore, Md.

By Ezra B. Whitman*

The new Loch Raven Dam, which is being built for the purpose of augmenting the water supply of Baltimore, is rapidly nearly completion. The necessity for the increased supply was recognized about ten years ago by Alfred M. Quick, who was then Water Engineer, and he proposed building a large impounding reservoir in the valley of the Gunpowder River. In 1908 the State Legislature passed an Enabling Act appropriating $5,000,000 for the purpose of making this improvement in the city's supply. This loan was ratified by the vote of the people in the fall of the same year.

Figs. 1-2. Loch Raven Dam for Water Supply of Baltimore, Md., in November, 1912, and November, 1913

Before proceeding with the construction of the dam in the valley of the Gunpowder, however, the city administration decided to call in outside experts, and John R. Freeman and Frederick P. Stearns were called upon to go over the entire question of improving the water supply for Baltimore. These gentlemen, after a most careful and thorough investigation, submitted a report on March 25, 1910, in which they recommended that the water supply be increased in practically the same manner as that recommended by Mr. Quick, viz., by building a large impounding reservoir in the valley of the Gunpowder River and by the building of a filtration plant.

Present Sources of Supply.

At the present time Baltimore takes its water from two sources. The main source of supply is from the Gunpowder River, which has a drainage area of 308 sq. miles above the existing dam. This dam is built of stone and is about 25 ft. in height above the bed of the river and is located about seven miles northeast of the city limits. The reservoir created by this dam is known as Loch Raven and originally had a capacity of 510 million gallons. This capacity has been greatly reduced by deposits of silt since the dam was completed in 1881. This long, narrow reservoir, extending between two high hills for a length of four miles, is now filled to such an extent that it has but little larger cross section than the normal cross-section of the river. By 1900 the capacity of the reservoir was only 78 million gallons, although dredging had been carried on from 1896 to 1900.

In 1900 the city purchased a suction dredge, which was operated continuously until the fall of 1911, the mud from the bottom of the reservoir being pumped through a long pipe line to a point below the old dam. This dredging increased the capacity of Loch Raven from 78 million gallons to about 178 million gallons. It is calculated that the annual deposit of silt from 1881 to 1909 was 226,000 cu.yd.

The annual yield of the Gunpowder River, according to records kept by the Water Department for the past 27 years, has averaged about 280 million gallons per day. The minimum flow of the stream, however, has been as low as 55 million gallons per day. The present water consumption of Baltimore is about 75 million gallons per day. From these figures it can be seen that if sufficient storage is obtained to store the waters, which at the present time passes over the dam during rainy periods, the stream flow of the Gunpowder River is sufficient to supply Baltimore with water for a number of years in the future. It is for the purpose of supplying this storage

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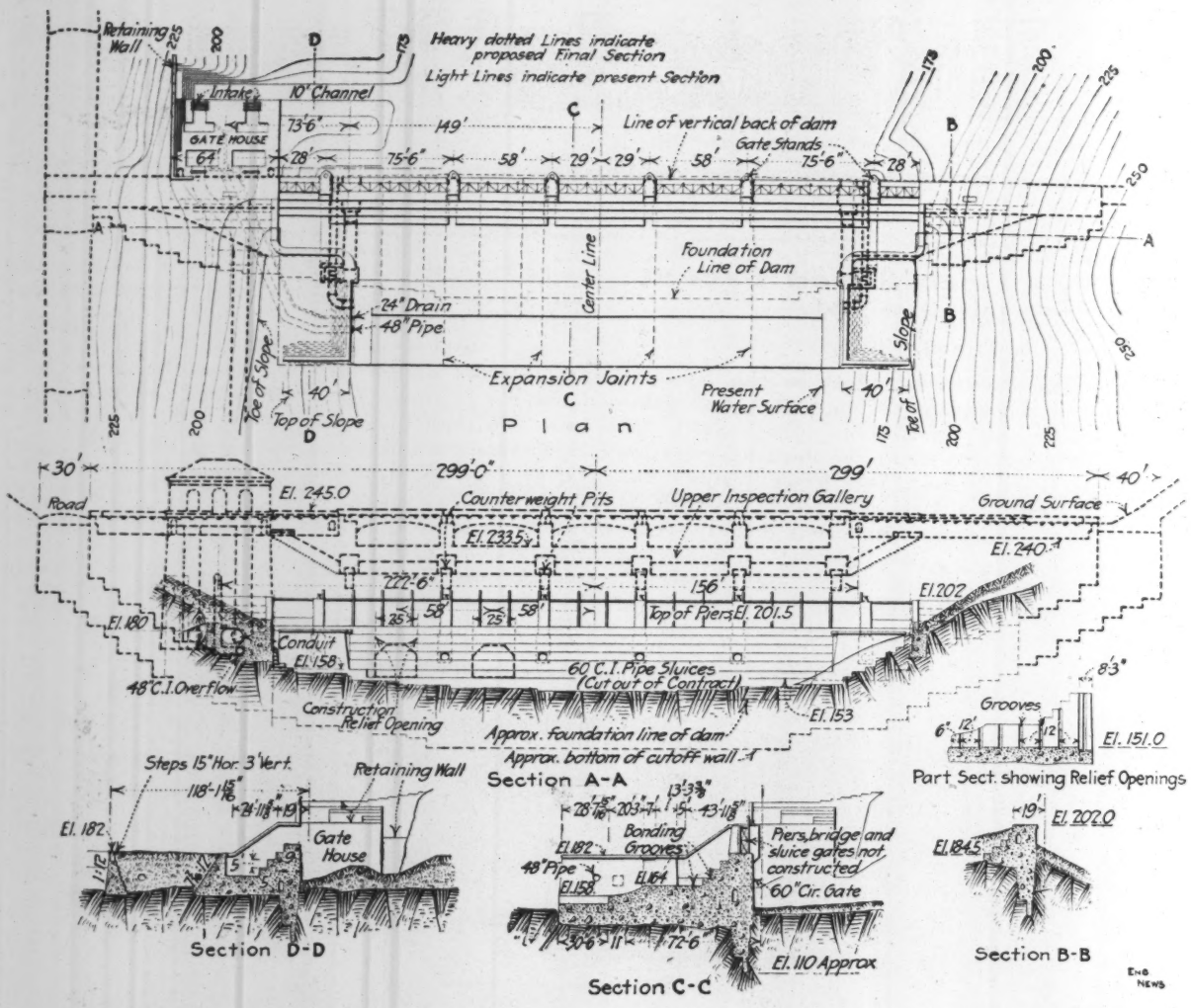


FIG. 3. DETAILS OF CONSTRUCTION OF NEW LOCH RAVEN DAM, BALTIMORE, MD.

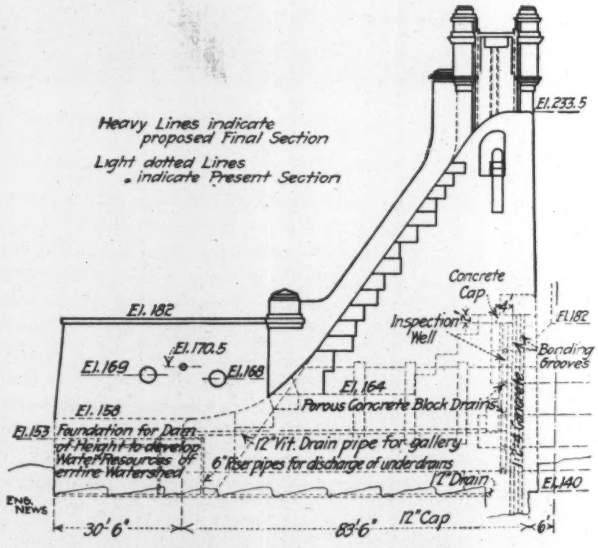
(Main drawing shows present section with final proposed section dotted; lower drawing shows final section with present section dotted.)

that the new dam at Loch Raven is being constructed.

From the gate house at the old dam at Loch Raven a tunnel seven miles long and 12 ft. in diameter leads to Lake Montebello, just within the city limits. This lake has a capacity of 496 million gallons and is connected by a 12-ft. tunnel with Lake Clifton, which has a capacity of 265 million gallons.

The second source of suply for the city is from Jones' Falls at Lake Roland. Jones' Falls has a drainage area above the Lake Roland Dam of about 40 sq. miles, and it was first used as a source of the city's supply about 50 years ago. Lake Roland is about five miles north of the city. The original capacity of Lake Roland was 400 million gallons of water. This capacity has been largely reduced by deposits of silt, but by means of dredging its present capacity is about 300 million gallons.

The population of the Jones' Falls watershed is over 150 persons per square mile and is increasing very rapidly. The stream flows through the Green Spring Valley, which has become a fashionable suburb of the city,



and there are many villages and handsome residences springing up in this valley. In addition to the pollution from the Green Spring Valley, two of the largest towns

in Baltimore County, Towson and Lutherville, are located on streams emptying into Lake Roland, after flowing only a few miles. The sanitary condition of this source of supply is rapidly becoming a menace to the city, but it cannot be completely abandoned until the new dam is completed at Loch Raven. The average daily yield of the Jones' Falls watershed is about 35 million gallons of water per day.

A masonry aqueduct 5 ft. wide, 6 ft. 4 in. high and about four miles long leads from Lake Roland to the Hampden Reservoir, which has a capacity of about 49 million gallons. Hampden Reservoir is connected with Druid Lake by cast-iron pipes, and Druid Lake has a capacity of about 428 million gallons.

During periods of heavy rain, when the Jones' Falls or Gunpowder River are in a very turbid condition, the gates at Lake Roland and Loch Raven are closed and the muddy water is allowed to go to waste, while the city is furnished with clear water from the storage lakes at Montebello and Clifton from the Gunpowder supply and at Hampden and Druid lakes from the Jones' Falls supply.

It can be readily seen that this method of bypassing the muddy water makes it impossible to make use of the greater part of the run-off of the quick thunder showers falling in the summer time, and it has often been necessary to draw down on the available storage supply in the city limits at a time whe nthe stream flow has been very low. This condition of affairs, however, has been remedied to some extent by the use of alum to settle the turbid waters in Lakes Montebello and Hampden. Before the introduction of the use of alum it had been necessary on several occasions to turn very muddy and turbid water into the city mains, very much to the disgust of the entire population of the city.

Capacity of New Dam.

A careful survey was made of the valley of the Gunpowder River for a distance of 10 miles above the old dam, from which it was possible to compute the capacities of reservoirs behind dams with variable crest elevations, and Table I shows the available storage and other data for dams built to various crest elevations:

TABLE I

Contour elevation	Area, acres	Capacity between contours, million gal.	Total capacity below contours, million gal.
320	11,350	64,863	190,956
300	8,557	48,756	126,093
280	6,407	18,466	77,337
270	4,928	14,508	58,871
260	3,977	11,642	44,363
250	3,169	9,059	32,721
240	2,391	3,695	23,662
235	2,144	3,253	19,967
230	1,866	5,343	16,714
220	1,442	4,116	11,371
210	1,116	3,131	7,255
200	770	2,166	4,124
190	489	1,323	1,958
180	211	458	635
170	97	177	177
158	....	....	.....

Messrs. Stearns & Freeman, from the stream-flow records of the department, computed Table II, showing the amount of storage that would have been required to supply from the Gunpowder River different daily quantities of water throughout the greatest droughts of 27 years prior to 1910. They first reduced, however, the stream-flow records on an average of 6% from the quantity shown by the departmental records in order to allow for obstructions on the spillway and for a different formula for computing the flow over the dam:

TABLE II

Average daily water consumption. (Million gal.)	Available storage capacity required. (Billion gal.)	Storage in equivalent inches depth over drainage area of 308 square miles	Length of longest continuous period that reservoir would have been below spillway crest
90	2.3	0.37	
100	3.5	0.56	
110	4.7	0.76	
120	6.2	1.16	1 year 2 months
130	8.6	1.61	1 year 2 months
140	10	1.87	1 year 6 months
150	13	2.44	1 year 7 months
160	16	3.00	1 year 7 months
170	21	3.94	1 year 8 months
180	27	5.06	1 year 10 months
190	38	7.13	3 years 0 months
200	47	8.81	3 years 8 months
210	57	10.7	3 years 10 months
220	66	12.4	3 years 11 months
230	75	14.1	4 years 1 month

Messrs. Stearns & Freeman also prepared Table III after a study of the water consumption of the city for a period of 39 years, and the growth in population of the city, in order to estimate the number of years in the future that the city could safely take it supply from the Gunpowder River:

TABLE III

Year	Years from now	Probable population: Per cent. growth for decade	Probable population: Estimated total	Probable quantity water used per capita per day, gal.	Total quantity of water probably required. Average million gal. per day
1915	5	..	660,000	130	86
1920	10	20	720,000	135	97
1930	20	17.5	850,000	145	123
1940	30	15	980,000	150	147

The crest of the dam can be carried to an elevation of 237 ft. above mean tide without making it necessary to flood the tracks of the Northern Central Ry. near Phoenix, Md., or to flood the town of Cockeysville, Md. To carry the flood line higher than this elevation would have caused a greatly increased expense. It will also be seen from Table I that the dam, with a crest elevation of 237 ft., would give a reservoir with a capacity of about 21 billion gallons. Table II shows that a reservoir with this capacity would give an average daily water consumption of 170 million gallons per day, which is approximately 2½ times the present consumption of the city. This amount of water, it will be seen from Table III, would probably meet the needs of the city until 1950 or later.

Another very important reason for carrying the flow line to this height is that it will make it possible to supply the water from the resulting reservoir by gravity to the filtration plant, which will in turn discharge the water at sufficiently high level to suply the middle service of the city without pumping and furnish a greater water pressure in the low-service district of the city, which is at present fed by gravity from the present Loch Raven Reservoir with a water elevation of 171 ft. A.M.T.

In order to make the greater part of this 21 billion gallons available, however, it will be necessary to build a pumping station to pump the water to the filters before the water falls more than ten feet below the crest of the proposed dam.

Owing to certain legal complications in connection with the purchase of property in the valley of the Gunpowder, it was first decided to build the dam to a crest elevation of only 192 ft., which would give a storage capacity of little over two billion gallons instead of the 21 billion gallons. This dam with a crest elevation of 192 ft., continued with the existing storage reservoirs in

the city, which have an available storage of about 1½ billion gallons, gives a total storage of 3½ billion gallons. This would furnish a safe daily capacity of about 100 million gallons of water.

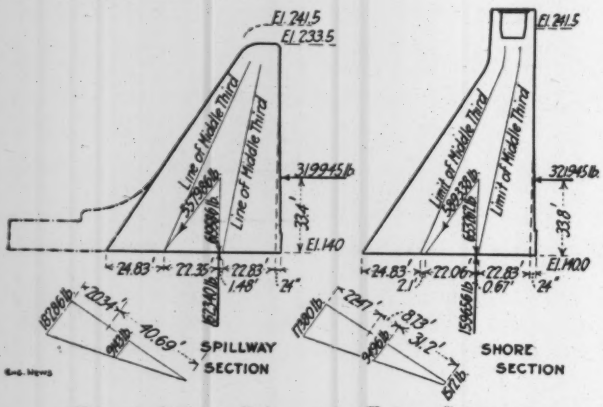


FIG. 4. STRESS SHEET FOR FINAL SECTION

It also developed that it would not be possible to build a dam with a crest elevation of 237 ft. and a filtration plant out of the $5,000,000 loan available for improving the water supply. The present city administration does not desire to ask for a further loan in order to build the higher dam, as the city is already greatly burdened with loans in carrying out the extensive improvements which have been made since the great Baltimore fire in connection with the new docks, new sewerage system, new street paving for the entire city, extension of the parks and improvement of the fire department and school systems. It has therefore been determined to build a reservoir which will have a crest elevation of 192 ft. at the present time, although the foundations for this dam have been laid of sufficient width, not only to extend the dam to an elevation of 237 ft., but to extend it to further elevation of 280 ft. if this should be demed desirable in the future.

DESIGN OF THE DAM

The accompanying diagram (Figs. 3 and 4) shows the sections of the dam which will be required when the crest is raised to an elevation of 233½ ft. It is proposed to secure a water level of 237½ ft. by placing flashboards upon this crest. In designing the dam provisions were made for flood water 8 ft. over the top of the masonry of the spillway, and an upward pressure is figured on the horizontal joints and on the bottom of the dam which is equivalent to two-thirds of the head of water at the upstream face, diminishing to zero at the downstream face of the dam.

The failure of the dam at Austin, Pa., at about the time that the designs for the Loch Raven Dam were being completed emphasized the necessity of taking every precaution to prevent upward pressure under the bottom of the dam and internal stresses within the body of the dam itself, due to water making its way into horizontal joints.

In order to take care of upward pressure under the base of the dam, a system of underdrains has been provided beneath the main foundation and next to the rock. A 12-in. drain with open joints is placed on the upstream side of the cutoff wall along the line of the bottom of the foundation of the dam, as shown on Fig. 5. Connecting to this drain are a number of 6-in. underdrains surrounded by gravel, which rest on the rock foundation, and it is expected that any water which may make its way through the cutoff wall or through the seams of rock on which the dam is built, will enter this drainage system without causing any appreciable upward pressure on the base of the dam.

The 6-in. underdrains are placed at intervals of approximately 30 ft., and they find outlet in risers leading to the top of the foundation apron near its lower end.

The author was familiar with the vertical porous drains used in the construction of the Olive Bridge and Kensico dams in connection with the improvements of the water supply of New York in order to intercept seepage through the body of the dam. It seemed more logical, however, that drains for this purpose should be placed horizontally across the construction joints, where the seepage would most naturally occur.

The upstream side of the dam for a thickness of about 7 ft., as shown on Fig. 3, is built of 1:2:4 concrete, laid in such manner that horizontal joints occur at vertical intervals of 8 ft. At these horizontal joints on the downstream side of the 1:2:4 concrete wall are laid conduits consisting of porous concrete tile laid in grooves left in this wall. These tiles are 14 in. square, 3 ft. long and are made of a dry 1:4:8 mixture, with the 6-in. interior diameter. Expansion joints are provided across the dam parallel to the axis of the stream at intervals of approximately every 60 ft., and at each expansion joint there is a vertical well to which the horizontal drains are connected. These vertical wells lead to a gallery

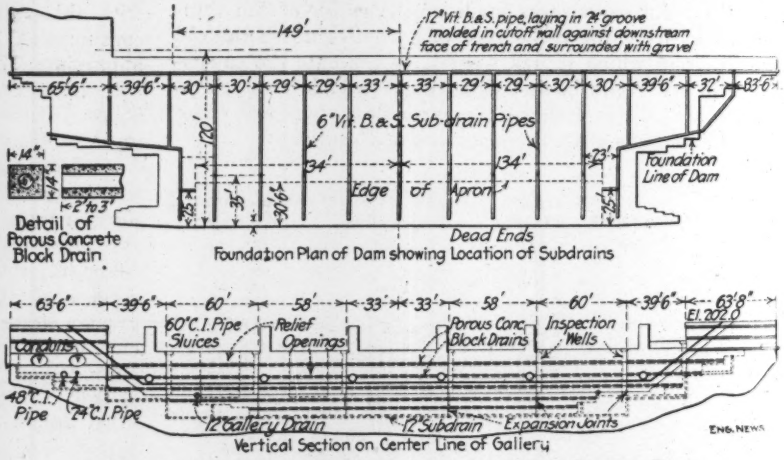

12" Vit. B. & S. pipe, laying in 24" groove molded in cutoff wall against downstream face of trench and surrounded with gravel
149'
6" Vit. B. & S. Sub-drain Pipes
Foundation Line of Dam
Edge of Apron
Detail of Porous Concrete Block Drain
Dead Ends
Foundation Plan of Dam showing Location of Subdrains
60° C. I. Pipe Sluices
Relief Openings
Porous Conc. Block Drains
Inspection Wells
Conduits
48" C. I. Pipe
24" C. I. Pipe
12" Gallery Drain
12" Subdrain
Expansion Joints
Vertical Section on Center Line of Gallery
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FIG. 5. DETAILS OF DRAIN PIPES IN LOCH RAVEN DAM

built throughout the length of the dam and which gallery drains into the tail waters on the downstream side of the dam.

Fig. 4 shows a section of the dam which is now being built to an elevation of 192 ft., and how the dam will be raised to the proposed crest elevation of 237.5 ft. The last three feet of the heights to bring the dams to these levels will be secured by means of flashboards.

Two 48-in. drain pipes are provided at elevation of

inverts of 164 ft. A.M.T., one on each side of the spillway, and these will make it possible to drain the lake should it ever be found necessary to do so. These gates will also be used while filling the relief openings which have been left in the first half of the dam to carry the water of the river during the construction of the second half.

Gate House

The gate house which will control the flow of the water into the city is built into the dam near the west bank of the stream, and will be so constructed that there will be duplicate gates which will make it possible to send water to the city through either one or both of the two gate chambers. Should any gate get out of order it will be possible by means of stop planks to shut the water out of the gate chamber, and a 24-in. drain for the gate chamber is provided, which will discharge into the tail waters of the dam. Provision is also made in this gate house to take water from varying depths.

During the summer time, when trouble may be experienced from the presence of algæ growths, the water for the city will be drawn from the bottom of the lake, as experience has shown that the algæ growths are much more numerous in the top layers than in the bottom layers. Should the dissolved oxygen become exhausted in the lower layers, and in times of turbid waters, when the top waters will settle clear much more rapidly than the bottom waters of the lake, the water will be drawn from the top.

The conduits connected with the two chambers of the gate house are each 8 ft. in diameter and will be brought together just below the gate house into one 10-ft. conduit, which is connected with a 10-ft. steel pipe line. This steel pipe is surrounded by concrete on the outside and lined with mortar on the inside, which lining has been placed by means of a cement gun, and is reinforced with wire mesh.

The gate house, when it is raised to the height recommended by the consulting engineers, will be provided with a hydro-electric plant which will generate electricity, the turbine being operated by the water passing to the city and by using the waste waters in excess of the water being consumed by the city. This current will probably be carried into the city limits and be used at the filtration plant.

The house which will be built over the gate chamber at the present time will be merely a temporary one of wood. A more permanent structure of stone or concrete would have to be soon torn down, as it is possible that the dam will have to be extended to the height recommended by Messrs. Freeman & Stearns in the course of the next ten years.

Bonding High Dam to Present Structure

When it is decided to carry the present structure up to the height originally recommended, it is proposed to place several rows of porous drains along the steps of the present dam, so that any water getting into the joint between the old and the new work will be intercepted before it can produce internal stresses, which would threaten the safety of the dam.

In order to bond the new structure to the old, large plum stones are placed projecting above the finished surface of the present structure, and these stones will be of great assistance to keep the new structure from sliding on the old. (Fig. 7.)

If it is decided that these plum stones will not furnish sufficient strength to prevent the sliding of the dam, holes can be drilled at regular intervals along the crest of the present structure, and iron bars can be grouted into these holes and extended into the new structure. It is believed that the system of drains combined with the plum stones and the iron bars will provide sufficient strength against sliding and provide for a sufficient bond between the new work and the old.

Materials of Construction

The stone of which the dam is constructed is taken by the contractors from a quarry located on the property of the city on the west bank of the stream, just below the old dam and about one-half mile below the bend where the new dam is being constructed. The larger stones taken from this quarry are used as plum

Fig. 6. Foundation Pit, Showing Seamy Rock Formation

Fig. 7. Plum Stones Imbedded in Present Dam Crest for Future Bonding

stone, while the smaller pieces are crushed by the contractor in order to furnish stone for the concrete. The stone from the quarry is a low grade of limestone, and it is also crushed and rolled in order to secure sand for the concrete. On account of its hardness, the contractor has experienced considerable difficulty in getting enough sand by this method to carry on his work, and he has been forced to buy sand from Baltimore city, from a company which secures the sand by dredging Baltimore harbor and the surrounding waters.

As already noted, the cutoff wall which extends below the foundation line and to the top of the upstream face of the dam is built of 1:2:4 concrete. The main body of the dam is built of 1:2½ concrete, in which are placed plum stones which amount to from 20% to 33⅓% of the total volume of the masonry in the dam, depending upon the part of the structure in which the plum stones are placed.

Every carload of cement that is used in the dam is sampled and tested before the contractors are allowed to use it.

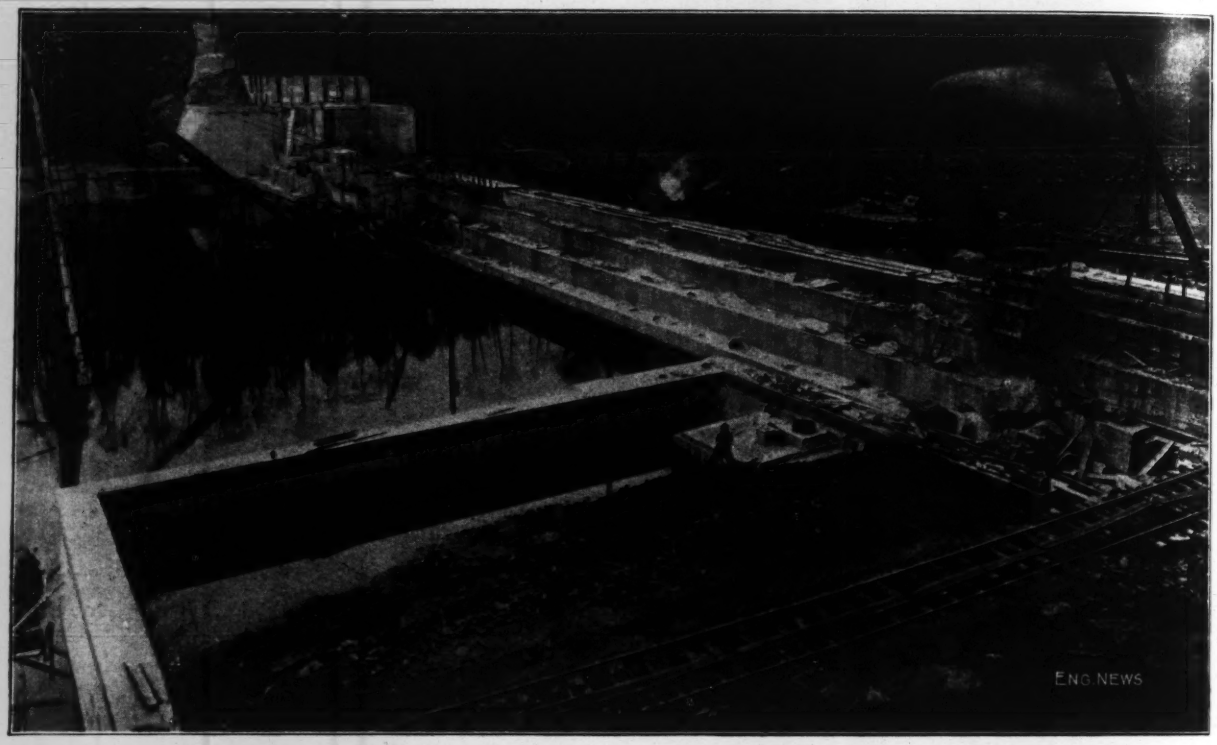


FIG. 8. VIEW OF LOCH RAVEN DAM, TAKEN MAY 4, 1914 SHOWING PRACTICALLY COMPLETED PRESENT STRUCTURE

CONSTRUCTION

The new dam is being built in the old Loch Raven Reservoir and the first half of the masonry was constructed inside of a coffer-dam, built to within about 50 ft. of the eastern shore of the old lake. (Fig. 1.) This coffer-dam was built of two rows of interlocking steel sheet piling placed about 15 ft. apart. There was about 15 ft. of mud and earth in the bottom of the old lake overlying the rock, and the sheet piling was driven through this mud and earth to solid rock. Upon the completion of the coffer-dam and in carrying out the earth excavation in the bottom of the lake, it was found very difficult to hold the earth on the inside face of the sheet piling so as to furnish proper support for the steel piling and the contractor was forced to place large stones on the inside of the coffer-dam against the inner row of sheet piling, which stone was afterwards used in the plum stone in the dam wherever it could be recovered.

This coffer-dam for the first half of the construction was very tight and the water was kept down in it by the use of a single 4-in. pump which did not need to operate constantly.

The rock encountered in the excavation is a mica schist, varying in hardness according to the amount of mica which was present. The rock was of a very seamy character, although there was little or no percolation through it excepting in the top strata, and the cutoff wall, which it had been proposed to carry down 30 ft., was stopped at a depth of about 15 ft. below the general excavation of the rock. Owing to the seamy character of this rock, which is shown in one of the accompanying views (Fig. 6), and the sharp tilt of the strata, there was no attempt made to secure a level bottom for the foundation, and the underdrains were placed over the seams between the strata at intervals of about 30 ft., instead of at right angles to the main underdrain on the downstream face of the cutoff wall.

The dam itself was built in blocks, forms being used to secure these blocks. The joints between these blocks were so arranged that there is no continuous horizontal joint throughout the dam.

Both the excavation and the placing of the concrete and the plum stones were handled from a number of derricks, which can be seen on Figs. 2 and 8.

When the first half of the masonry structure was completed, the contractors, largely through overconfidence lulled by the ease with which the water was handled in the first half of the dam, built the portion of the coffer-dam parallel to the axis of the stream and upon the completed structure of wooden plank instead of the steel sheet piling.

When the coffer-dam for the second half of the dam was completed it was found that this portion of the coffer-dam leaked very freely and the work of proceeding with the structure of the second half of the dam was delayed for several months before the coffer-dam could be made sufficiently tight to work inside of it.

Personnel

The original plans for this dam, before being revised by the writer, were drawn by former Water Engineer Alfred M. Quick, and the design and construction have been directly under the supervision of Emory Sudler, then Division Engineer of the Gunpowder Supply improvements. The Assistant Division Engineer, P. A. Beatty, assisted in the design of the dam and has been in immediate charge of its construction and the construction of the roads, conduits and bridges, which are incidental to the construction of the dam. The Resident Engineer at the dam was Talbott Todd, who resigned his position with the city to take charge of the construction of the dam for the contractors in August, 1913. Mr. Todd was succeeded by Everett Patterson, who is now the Resident Engineer in charge of this work.

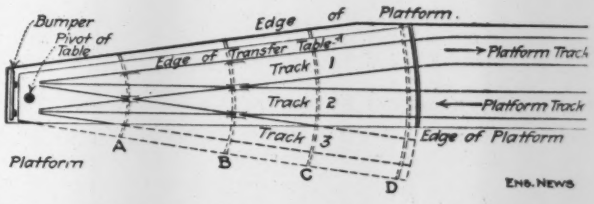
A Swinging Transfer Table for Shifting Locomotives

In the new Snow Hill station of the Great Western Ry. at Birmingham, England, there is a pair of stub tracks for local service and it was desirable to provide means for promptly switching out the engine of an inbound train. This is effected by the use of a segmental or fan-shaped transfer table, pivoted at the extreme end of the tracks. This is shown in the accompanying cut.

The table has three tracks radiating from the pivoted end. Two of these tracks are normally in line with the converging ends of the inbound and outbound tracks. When a train stops on the inbound track, the engine is uncoupled and runs onto the transfer table. This is then swung to bring its engine track in line with the outbound track, and at the same time its third track is lined up with the inbound track. In this way the pit is kept closed all the time and there is no liability of derailing cars in case of accidental movement while the engine is being moved. As soon as the engine is run off, the table is returned to its normal position. It will be understood that the station has high platforms, level with the floors of the cars, so that the transfer-table pit and the dead side of the table extend under the platforms.

The table is about 70 ft. long, with widths of 13 ft. and 39 ft. at the inner and outer ends. This width is between the centers of the two side or radial girders, and these girders are connected by four curved transverse girders, between which are framed parallel longitudinal girders, all covered by a steel deck. Under each cross-girder is a curved rail on the floor of the pit, for wheels carried by the girder framing. The pivot and bumping block are carried by a substantial masonry pier.

Upon the framing (beneath the deck) is mounted a motor-driven drum, upon which is wound a cable having its ends anchored to the sides of the pit. The travel (at the circular end of the table) is about 8 ft. 6 in. The



Plan of Swinging Transfer Table for Shifting the Locomotive of an Inbound Train to an Outbound Track at the Snow Hill Station of the Great Western Railway, Birmingham, England

(A, B, C, D are transverse girders of the table, with wheels riding on curved tracks in the floor.)

operation is controlled by a lever on the platform and this is interlocked with the signal equipment, so that the table cannot be operated without the knowledge of the signalman who handles the train movements at the station.

The Magnitude of the Aluminum Industry is shown in the following table, which gives the production since the beginning of the industry in 1883 and the domestic consumption of the metal since 1904:

1883	83	1900	7,150,000
1884	150	1901	7,150,000
1885	283	1902	7,300,000
1886	3,000	1903	7,500,000
1887	18,000	1904	8,600,000*
1888	19,000	1905	11,347,000*
1889	47,468	1906	14,910,000*
1890	61,281	1907	17,211,000*
1891	150,000	1908	11,152,000*
1892	259,885	1909	34,210,000*
1893	333 629	1910	47,734,000*
1894	550,000	1911	46,125,000*
1895	520,000	1912	65,607 000*
1896	1,300,000	1913	72,379,000*
1897	4 000,000		
1898	5,200,000	Total	377,737,779
1899	6,500,000		

*Consumption. The figures for 1913 do not include the weights of imported leaf aluminum, valued at $1228; table, kitchen and hospital utensils, valued at $40,947, and "All other manufactures" of aluminum, valued at $353,844. The secondary aluminum produced in 1913 was 2198 short tons; the quantity of recovered aluminum contained in alloys was 2456 short tons.

The use of the metal is now being extended on a much larger scale, as in the construction of welded tanks, cooking vats and vessels which are employed by brewers, preserve manufacturers, fat recoverers and in similar industries where a metal that will conduct heat, will not corrode and is not poisonous is essential.

Other uses for aluminum vessels on a large scale are in the manufacture of essences and syrups, varnishes, fatty acids, edible oils and nitric acid. A large number of firms abroad are using aluminum in the varnish-making industry. Welded aluminum tanks are now being employed for obtaining and measuring acid and for piping and conveying the acid in the works. A number of aluminum tank cars have been made for the conveyance of strong nitric acid in bulk and the results have been satisfactory. The use of aluminum wire as a conductor in long-distance power-transmission schemes is not new. A recently developed branch of the aluminum industry is the manufacture of powdered metal which is used extensively as a paint pigment, in explosives, in lithographing and in printing. Aluminum foil, though not exactly a new product, is now being used on a larger scale than ever before, owing to improved methods in its manufacture after long and expensive experiments which have reduced its cost appreciably. Aluminum foil has partly displaced tinfoil for wrapping articles such as cheese, chocolate candies and tobacco.

Design and Construction of Outfall Sewer, Carlisle, Penn.

By C. A Bryan*

The main outfall sewer conveying the sewage from the borough of Carlisle, Penn., to the disposal plant is about 1.5 miles in length (see plan and profile, Fig. 1). It is constructed of 18- and 24-in. double-strength terra-cotta pipe. It follows in the general course of the Letort Spring, a shallow stream which flows through the eastern portion of the borough.

Design of the Outfall Sewer

The sewer was designed to carry the sewage from a population of 25,000, and was designed on the assumption: (1) that the average amount of sewage contributed to the system per capita per day would be 100 gal., and (2) that there would be an infiltration of ground water into the main amounting to 5000 gal. per mile of sewer per day.

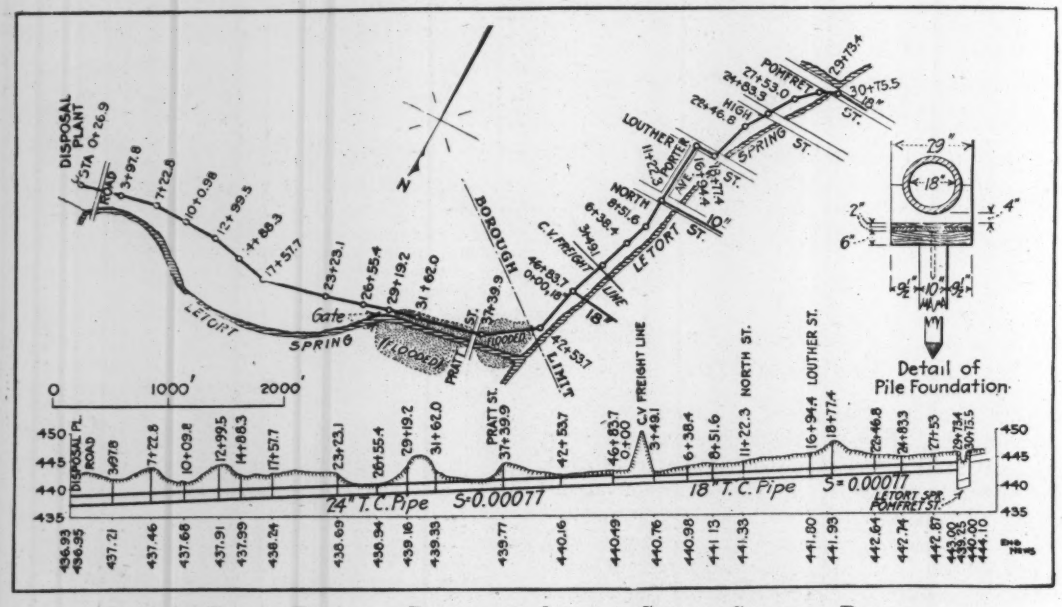


Fig. 1. Plan and Profile of Outfall Sewer, Carlisle, Penn.

The sewage from the town is discharged into the main outfall at three points, the sizes of the branch mains being 10, 15 and 18 in., respectively (see article on this sewerage system in general, by the present writer, in Eng. News of July 2, 1914). The total fall available between the point where the main sewer draining the southeastern portion of the borough joins the outfall at the corner of South and East streets, and the site selected for the plant, is 8 ft. The velocity of flow through this sewer was fixed at 1.75 lin.ft. per sec. and the gradient determined in accordance therewith. At every 90° turn in the line a drop of 4 in. was made in the manhole at that point, and at the other turns the amount of fall allowed at the manhole varied from 1 to 3 in., depending upon the sharpness of the turn.

A careful study was made of the topography of the section through which the sewer passed, and the sewer was so located as to permit its construction in the shallowest cut possible and at the same time provide a cover of at least 2 ft. over the pipe. This was considered essential because the line, once outside the borough limits, was laid out through cultivated fields.

Construction of the Sewer

Bids for the construction of the outfall were received in March, 1913, and the contract was awarded to the lowest bidder, J. I. Dick, of Scottdale, Penn., at $13,098.

Excavation—Construction work was not started very promptly as the contractor had other work which he wished to finish, and again, in the judgment of the engineer, the work was not of sufficient magnitude to raise any doubt as to the contractor's ability to finish it within the specified time limit of 180 days. Work was started in June, however, and, as a comparatively small force was employed, it was not finished until February, 1914. The principal cause of this delay was the fact that the contractor expected to have only a small quantity of rock excavation, but once construction work was started a large amount of rock was uncovered. The contractor, not being well equipped to handle this rock, kept opening up more and more trench in the hope of finding some dirt excavation, with the result that he finally had 4000 lin.ft. of trench opened and no pipe laid. At this point the engineer was obliged to shut down on this procedure and no further trench was laid out until the pipe had been laid in the trench already opened up. Progress on this portion of the work was necessarily slow because the contractor did not have the machinery to handle the work economically nor did he seriously consider the purchase of suitable apparatus until the work was nearly completed. Figs. 2, 3 and 4 give an idea of the amount of rock encountered at points where little or no rock was anticipated.

During construction, no serious difficulty was experienced. The majority of the excavation was in dry material, only about a half-mile of the pipe being laid in wet trench. Probably the worst stretch encountered lay

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between High and Pomfret streets (Fig. 1) where the line passed through a truck patch. Here the material excavated was a sort of marl, saturated with water. It provided no foundation for the pipe and a pile-and-plank foundation was built to support it (Fig. 1). This entire section had to be closely sheeted, and it was found necessary to drive the sheet piling fully 2 ft. below the invert of the pipe to prevent the material from breaking through underneath the sheeting. The crossing under the freight track of the Cumberland Valley R.R. was made in tunnel and was carried through without trouble, although the tunnel was about 150 ft. long and was driven through filled ground.

ROCK DRILLING—The rock on the outfall sewer was drilled by means of Rand jack-hammers or butterfly drills, operated by steam (Figs. 5 and 6). Two of these hammers were operated by an 8-hp. vertical boiler, which supplied steam to them through 1-in. pipe. It was found that the steam could be carried a distance of about 150 ft. from the boiler before condensation became too great to permit the operation of the hammers. This necessitated the moving of the boiler every 300 ft. When but

CONSTRUCTION VIEWS ON THE OUTFALL SEWER AT CARLISLE, PENN.

(Figs. 2, 3 and 4 show the unexpected amount of rock encountered. Figs. 5 and 6 show steam jackhammers or butterfly drills at work.)

one drill was in use it was found that steam could be carried from 200 to 250 ft. before becoming too cold.

From the results obtained by this contractor in drilling the rock in the manner described the following conclusions have been drawn: (1) Butterfly drills operated by steam will not put down holes in solid rock over 5 or 5.5 ft. in depth. (2) Where a seam of soft or shattered rock is encountered the steam drill will clog and refuses to go through, often necessitating shooting shallow holes and redrilling after cleaning out the soft seam. (3) The heat under which the operator was obliged to work was excessive, and this heat and the exhaust steam necessarily tended to reduce the efficiency of the operator. In deep ditches and also under certain atmospheric conditions, steady work was impossible. (4) The cost of the maintenance and operation of the plant was excessive. The writer is convinced that the cost of drilling the rock on this work could have been more economically handled by the use of a portable air compressor.

Sewer Joints—As stated, the entire 24-in. portion of the line was constructed during the summer months and at a time when there was little or no water in the trench to contend with. Joints were made in the usual manner, using a rich cement mortar which was prevented from pushing through to the inside of the pipe by first wrapping a strand of jute around the spigot end of each pipe as it was inserted into the bell end of the pipe previously laid. To further aid in keeping the mortar in place, a piece of muslin 9 in. wide was wrapped completely around the joint and held in position by tying at the top of the pipe. An inspector was present on the work practically all of the time, and was especially careful to see that the bottoms of the joints were well made and the pipe well laid.

During the winter months, the meadow marked *A* on Fig. 1 is flooded by the authorities of the Carlisle Indian School for the purposes of a skating pond, and under present conditions about 1200 lin.ft. of the outfall sewer along this meadow is subjected to a head of about 6.5 ft. of water, amounting to a pressure of about 15 lb. Under these conditions the infiltration of ground water into the main is excessive. Measurements taken at the manhole nearest the point *A* have shown a stream 10 in. deep flowing through the sewer.

A careful examination of the barrel of the pipe has failed to reveal any excessive leakage at any one joint, but water seems to enter the pipe through numerous pores in each joint. Various attempts to repair this leakage have proven in general unsuccessful. The writer is satisfied that the joints were carefully made and the pipe well laid, and this at a time when the ditch was dry.

Leakage at this point is unquestionably increased by the fact that throughout this distance the pipe is laid in a shallow cut, and through rock. For this reason the back-filling is much more porous than it would have been had the pipe been laid in dirt excavation.

The fact that so much leakage has developed under the conditions cited has raised in the mind of the writer the question whether after all cement joints are the most satisfactory joints for use on sewer construction.

Cost of Construction

The unit prices upon which the contractor's bid was based were as follows:

Material	Diam., in.	Depth, ft.	Price
Terra cotta pipe	24	0 to 4	$1.30 per lin.ft.
Terra cotta pipe	24	4 to 6	1.52 per lin.ft.
Terra cotta pipe	24	6 to 8	1.82 per lin.ft.
Terra cotta pipe	24	8 to 10	2.22 per lin.ft.
Terra cotta pipe	24	10 to 12	2.72 per lin.ft.
Terra cotta pipe	18	4 to 6	1.33 per lin.ft.
Terra cotta pipe	18	6 to 8	1.48 per lin.ft.
Terra cotta pipe	18	8 to 10	1.53 per lin.ft.
Terra cotta pipe	18	10 to 12	1.58 per lin.ft.
Terra cotta pipe	18	12 to 16	1.62 per lin.ft.
Terra cotta pipe	18	16 to 18	2.25 per lin.ft.
Rock excavation			2.85 per cu.yd.
Brick manholes			4.00 per vertical f
Cast-iron frames and covers			18.00 apiece, compl
Concrete masonry			6.50 per cu.yd. in

The price paid by the contractor for labor was $2 day of 10 hr.

The final estimate for this work amounted to $21,7 or a cost to the borough of $2.91 per lin.ft. of complet sewer, including engineering and inspection. Record kept during the construction show, up to the point wh the line crossed High St. (Fig. 1), a profit of about $8 to the contractor. It is probable that this profit was lost in the construction of the remaining distance to Pomfret St. on account of the difficulties to which reference has previously been made.

The cost of the outfall sewer will be met by a general assessment on the assessed valuation of the entire borough.

This sewer was designed by and constructed under the supervision of T. Chalkley Hatton, now Chief Engineer of the Sewerage Commission of Milwaukee, Wis. The writer was the resident engineer in charge of construction and Leo D. Skemp was the superintendent of construction.

A Controversy Over the Question of Force Account versus Contract Work at New Orleans

We have recorded in recent issues of Engineering News the extent to which some cities are carrying on work at the present time by the direct employment of labor, or by force account as it is commonly called, instead of by letting contracts. In our issue of July 16 we described the manner in which the city of Minneapolis is carrying out over three and one-half million dollars' worth of construction work without letting contracts. It is the general rule, however, that this plan of carrying on work meets with serious opposition. In many states stringent statutes are in force requiring that all public work shall be done by contract and shall be advertised and let to the lowest bidder. There are many engineers who believe that while in exceptional cases work can be carried on efficiently by day labor, the general liability to political interference, etc., is such that on the whole the contract system is to be preferred.

The city of New Orleans is just now the seat of a lively controversy respecting the manner in which the extensions of its water-works and sewerage system should be made. As many of our readers will recall, the building of a sewerage system for New Orleans was not undertaken until 1903. In the four years from 1903 to 1907 a large amount of work was done. The main trunk and outfall sewers were constructed and a large part of the business and residence portions of the city were provided with sewers. All this work was done by contract.

In September, 1907, bids were received on four addi-

tional contracts for sewer extensions. These bids were found to be about one-third greater than the engineers' estimate of the cost; and this fact, together with the limited appropriation available, caused the bids to be rejected. The Sewerage and Water Board then determined to undertake the construction of these sewers by force account after receiving a legal opinion that they had authority to carry on the work in this way.

In the six years since that time all work on sewer extension work has been done by force account, no contracts being let. The Board has built in this time 193 miles of sewers, from 8 in. to 27 in. in diameter, at a total cost of $1,312,000. The work done by contract previous to that time had cost about $5,000,000. In 1910 the Board further adopted the policy of building by force account all extensions to the city's water distribution system. Heavy construction work on the city's storm-water drainage system, however, is still done by contract.

As was to be expected, the conduct of work by force account excited criticism and antagonism. Claims were made that the Board had no legal right to carry on its work in this manner. The controversy appears to have become a political issue and was carried into the State Constitutional Convention held last fall. This convention inserted a clause in the constitution empowering the Board to continue to do its work either by force account or contract until Sept. 1, 1914, providing that any single piece of work exceeding in cost $25,000 should be let to contract and further providing that the State legislature, at its session in the spring of 1914, might determine whether the permission to the Board to work by force account might be extended beyond Sept. 1.

In view of the large amount of criticism and discussion concerning the work done under the direction of the Board, a special investigation committee was appointed in December last, consisting of Messrs. J. F. Coleman and Arsene Perrilliat, and Prof. W. B. Gregory. This committee was requested to report as to the comparative cost of the work done by force account and by contract, and also as to the organization and efficiency of the Board's staff with the adequacy or inadequacy of the salaries paid.

This committee presented its report, May 6, 1914, and stated that the design and execution of the drainage, storage and water systems of New Orleans are exceptionally good and reflect great credit upon those who are responsible therefor. The committee then proceeded to a discussion of the relative merits of contract work and force account, and concluded that under the same terms and conditions the work could be done by contract at a lower cost and yet with a reasonable profit to the contractor. The committee therefore recommended that the work of extending water, drainage and sewer conduits should hereafter be done wholly by contract, but that the making of sewer and water house connections and the maintenance of the system should be done by the Board's own forces. The committee also made an elaborate report upon the organization of the Board's engineering and other departments and submitted certain recommendations for its reorganization.

At the same meeting of the Sewerage and Water Board, at which the report of the investigating committee was presented, George G. Earl, General Superintendent for the Board, submitted a report emphatically contradicting the investigating committee's statement as to the advantages of contract work and showing that in every respect the city had been the gainer by the adoption of the force account plan. Mr. Earl stated that on the contracts for which the bids were rejected in the fall of 1907 their execution by force account showed a saving of at least $562,000 to the city as compared with the prices bid by the contractors. Engineers desiring a forceful discussion, pro and con, of the subject of force account vs. contract work would do well to apply to the Sewerage and Water Board of New Orleans for copies of the reports.

Following these two reports, the Board instructed its counsel to submit to the legislature a bill which would permit it to continue the policy of doing work by force account within the limit fixed by the constitution. It further submitted the whole matter to a board made up of Messrs. Rudolph Hering, George W. Fuller and Harrison P. Eddy. The report of this board, dated June 20, 1914, has just been printed. This board fully sustains the Water and Sewerage Board of New Orleans in its policy of carrying on work by force account. One of the strongest paragraphs of its report we quote as follows:

> If the legislature should decide to discontinue the right of the board to do force account work, it will place the city in the embarrassing position of being obliged to accept the prices bid, whether high or low, or not do the work. Should the bids appear to be too high, the board, of course, can reject them and call for new bids with a delay of from three to four months; but if the board cannot do the work with its own forces these bids may be practically as high as at first. In other words, the board will be entirely at the mercy of the contractors at times when contractors are busy and bidding high prices as well as when there is a scarcity of work, and even in case of a combination of bidders to artificially inflate prices.

In addition to the report, Messrs. Fuller and Eddy gave testimony before committees of the Louisiana legislature on June 22. The legislature before adjourning enacted the bills desired by the Sewerage and Water Board, giving it permission to continue to carry on work by force account. These bills were transmitted to the Governor who submitted them to a so called "pocket veto." Had he returned them to the legislature with a veto message, it is said that they would have been passed over the veto as the vote in their favor was nearly unanimous. By merely retaining the bills, however, in his possession until after the legislature had adjourned the bills failed to become law.

Good Roads for Little Money are being constructed in Louisiana, where rock and other expensive road-making materials are rare. The work is done under the State Highway Department, which is a subsidiary department of the Board of State Engineers. The Highway Department, in all its work and discussions before the Farmers' Institutes and other meetings, has tried to make it clear that road improvement does not necessarily mean the construction of the highest type of roads, except under certain traffic conditions, but attention should be given to those methods by which the best results can be obtained with the money that is, or will be, available for the various highway projects. The accompanying table gives a summary of road work during the past six years.

Parish	General Character	Mileage	Cost	Average cost per mile
Natchitoches	Earth	37.23	$29,021.01	$779.51
DeSoto	Sand-Clay	50.39	43,797.59	869.17
Ouachita	4¼ Miles Graveled, 13 Miles Earth	17.25	25,089.16	1,454.44
Rapides	Earth	3.57	3,273.50	916.94
East Baton Rouge	Earth	22.22	23,400.53	1,053.13
Orleans	Earth	15.50	16,110.11	1,039.36
City of Baton Rouge	Wide Gravel	0.82	5,023.08	6,125.71
St. John the Baptist	Earth	8.00	7,200.00	900.00
Total		154.98	$152,914.98	

Road-Oil Specifications and Tests*

By Clarence B. Osborne†

In the preparation of specifications for asphaltic oil for road building the engineer has three problems presented; (1) He must have requirements controlling the chemical purity of the oil, i.e., he desires an oil that is free from foreign material and products of decomposition produced during refining; (2) He must control the chemical composition of the oil; (3) he must control the physical properties of an oil so that it will actually perform its proper function in the road construction.

Specifications for chemical purity of road oil are as follows:

(1) It shall not contain more than one-half of one per cent. of sediment by volume.

The presence of even ten times this amount of sediment is not detrimental, as the oil in use on the road eventually carries as high as 90% of mineral aggregate. This specification is used to prevent the buying of sediment at the price of road oil.

(2) It shall not contain more than one per cent. of water by volume.

The presence of water in a road oil makes the oil difficult to handle when heated above 212° F., because the steam formed makes the oil boil or froth. Also, as in the case of sediment, unless the proper deduction is made water will be paid for at the price of road oil.

(3) It must, when freed from water, be soluble to at least ninety-nine and five tenths per cent (99.5%) in pure carbon disulphide.

This will give the per cent. of bitumen in the road oil.

(4) The bitumen soluble in carbon disulphide must be soluble in carbon tetrachloride to the extent of at least ninety-nine per cent (99.0%).

The failure to pass this specification is supposed to be an indication of an over-heated or "cracked" oil. Carbon tetrachloride is not a stable solvent in bright light and the solubility test is influenced if the test is performed in bright light.

Another specification sometimes used to determine a "cracked" oil is as follows:

(5) In CS_2 bromide solution. The bitumen soluble in carbon disulphide must be soluble to the extent of at least ninety-nine and eighty-five one hundredths per cent. (99.85%) in a solution of one hundred and thirty-five (135.0) milligrams of bromine to one hundred (100.0) cubic centimeters of the carbon disulphide, when twenty-five (25.0) cubic centimeters of the solution are poured on two (2.0) grams of the oil in an Erlenmeyer flask, which is then shaken in the dark for three (3.0) minutes, the solution being immediately filtered through a Gooch crucible using a suction equal to a column of mercury more than eight (8.0) inches high.

When the solution has all passed through the crucible, the crucible is washed with pure carbon disulphide, dried at from two hundred and twelve (212.0) to two hundred and twenty degrees Fahrenheit and weighed.

This test had its origin in the examination of vegetable and animal fats. The unsaturated fatty acids form insoluble bromides. This bromide carbon disulphide solvent is not stable, however. An oil having an excess of 0.15% of insoluble material would fail to pass this specification, and yet this failure might be due entirely to the unstable solvent.

The specifications to govern the different constituents that make up the bitumen of the road oil are partly included in the specifications numbered (3), (4) and (5).

The road oils are generally classified as to their asphaltic content. This asphalt is not a definite chemical compound determined by chemical analysis. To determine the asphaltic content, the road oil is hardened by heating it in an asphalt oven at a high temperature. The oil, of the light or volatile oils, is driven off in this heating and the residue is hardened. The degree of hardness is measured by the depth of penetration of a No. 2 needle when acting under a load of 100 grams for 5 seconds, the residue being maintained at 77° F. If the needle penetrates 8 mm. in this test the residue, called asphalt, is said to be asphalt of 80 penetration. As can readily be seen, this residue may contain many different bitumens. The test is not a measure of a definite chemical compound.

If the assayer for copper should call all the metal extracted "copper" when the metal was of a certain hardness, then it can readily be seen that any alloy of soft and hard metals that made this certain hardness would be classified as copper. This is the practical result of the specification for a road oil when it is required to contain a certain percentage of asphaltum.

The early oil-bound macadam roads built with asphaltic oils usually required an oil containing 70 to 75% of asphalt of 80 penetration. This oil was not heavy, that is, it lacked body (i.e., low viscosity), and it was a weak binder but it was easily applied to the road surface.

The use of pressure tank wagons with sprayers for appliying heated road oil has made it possible to use an oil of much higher asphalt content and of higher viscosity. The road oil that is now commonly demanded for oil-bound macadam, or for bituminous-covered concrete highways, is one that contains 90% of 80 penetration asphalt. The following specifications are suggested for such an oil:

(6) It shall contain 90 per cent. of 80 penetration asphalt.

This per cent. of asphalt is determined by heating 20 grams of the road oil in a 2-oz. salve tin in a standard asphalt oven, the temperature of the oven being maintained at 400° F. When the asphaltic residue has a penetration of 80, the oil shall not have lost in excess of 10% by weight.

The asphaltic content is the classification of the oil refineries of their different grades of road oil. The specification is of value more on this account than for any information of practical value furnished to the road builder.

(7) It shall show an open flash point not less than 350 degrees Fahrenheit.

This requirement prevents the use of an oil carrying very volatile constituents that would readily evaporate and might also be dangerously combustible at the time the oil was being sprayed on the road at the high temperature necessary for spraying.

The physical properties of a road oil are of the greatest importance to the road builder. The following specifications deal directly with the measurement of the important physical properties:

(8) It shall show a float test of not over 1000 seconds when tested at 90 degrees Fahrenheit. This test is described in Bulletin No. 38 issued by the Office of Public Roads, United States Department of Agriculture.

*Reprinted from the "California Highway Bulletin" for July, 1914.

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This float test is the measurement of the viscosity of a road oil. The requirement will prevent the use of excessively viscous road oil, one that is difficult to apply and is slow to absorb the mineral aggregate necessary to the building up of the proper wearing surface.

(9) The oil shall show a specific viscosity of not more than one hundred (100) when tested with the Engler viscosimeter at a temperature of two hundred and twelve (212) degrees Fahrenheit.

This test will prevent the use of an oil that is too viscous to be readily applied to the road surface from the oil-spraying wagon.

(10) It shall show an adhesive test of not less than 300 seconds for three revolutions with the Osborne adhesive machines, when the oil is tested at a temperature of 77 degrees Fahrenheit, the load being 3 kilograms.

This test is the measure of the oil's power to prevent relative motion of two concentric cylinders when the oil acts as a binder between the surfaces of the two cylinders. The inner cylinder is 1.995 in. in diameter, the outer cylinder is 2 in. in diameter, the outer cylinder being in the form of a loose collar 2 in. wide. Its inner surface is coated with the oil to be tested. The outer surface of the inner cylinder is coated with oil and the collar then forced on the inner cylinder, which is maintained in a stationary position.

The outer collar is wound with cord to which a three-kilogram weight is attached; the pull of this weight causes the collar to revolve; the thin film of road oil between the two cylinder surfaces offers a resistance to this turning. The temperature of the oil being tested is maintained at 77° F. by means of water circulating in the inner cylinder. The measurement of the adhesive value of the oil is the length of time required for three complete revolutions of the collar.

Oils containing the same percentage of asphaltum will often show the greatest difference in their binding properties. Oils possessing the same viscosity will likewise often show a wide difference in adhesiveness.

As an example, one oil may be largely made up of heavy lubricating grease, another may be very free from lubricating material but they may both flow through a given-sized orifice at the same rate, when heated to the same temperature, that is, they have the same viscosity. The lubricating oil would lack binding power and be unsatisfactory for road construction; the other would be desirable. The adhesive specification would prevent the use of the unsatisfactory lubricating oil.

The asphalt contained in a road oil is required by some road builders to possess a certain ductility.

(11) The ductility of the asphalt which has been reduced to a penetration between 75 and 85 shall not be less than 110 centimeters.

This test is made with asphalt maintained at 77° F. and the pulling shall be at the rate of 5 cm. per min., using the Dow ductility machine.

There is a woeful lack of uniform specifications for road oil and uniform methods of performing the tests. In the determination of the asphaltic content of an oil, the temperature for the asphalt oven is specified sometimes at 325° F., and from that to as high as 500° F.

The dish containing the road oil during the reduction is in some laboratories as small as a thimble, and in others, large enough to hold 500 grams; sometimes cylindrical, and other times semispherical in shape. Some tests require the use of an oven, others require heating in the open air. As has been shown, the "asphaltic content of an oil" is, at best, a rather indefinite term, and when we have added to this the different methods used and the wide range of equipment used, the "asphaltic content" becomes even more of a vague description.

The asphaltic road oils are, for the most part, a by-product of the oil refineries. They are a relatively cheap material. This cheapness saves the road oils from being adulterated with other material. It is expensive to add anything to the oil. The natural oil itself rarely carries undesirable material. The tests for water and sediment will take care of foreign materials brought in by the crude oil.

Some road engineers have regarded oil containing sulphur as dangerous to use because the sulphur is supposed to make the product unstable. Many oils and asphalts carrying sulphur have given good service for long periods of time and if sulphur does tend to make the oil unstable, this action is too slow to be of importance in the life of the oil used in the road construction.

Notes on Maintenance of Wachusett Reservoir

By J. A. Cushman*

Much has been published concerning the construction of the Wachusett Dam and Reservoir of the Boston Metropolitan Water Supply, but little has been written about its maintenance. A few interesting, if not important, points have developed since this great reservoir was completed and filled, which maintenance engineers, and indirectly, construction engineers as well, may find valuable.

Survey Reference Marks

The first is in regard to the maintenance of construction benches, reference hubs or traverse points, and intermediate triangulation stations.

The bottom of the Wachusett Reservoir was striped of all soil. Preliminary to this stripping, the whole area was laid out in 500-ft. squares over which elevations were taken every 25 ft. The corners of the large squares were marked by chestnut hubs, 3 in. square on top and tapered to about a ½-in. sq. in their lengths of 3 ft. These hubs were guarded by triangular fences to prevent their being disturbed as the soil was removed. Of course, a great proportion of these hubs were within the site of the reservoir—only a comparatively few of them on the edges coming above the high-water line. In the final clearing of the basin all the hubs below the flow-line and all which were on the edge and liable to be washed in, were removed, leaving very few points for future use.

In a reservoir several miles long, the lack of a few such points is liable to cause considerable inconvenience, to say the least, at some time. The writer, therefore, suggests that, before such wholesale removal, new hubs or points be placed on the line of hubs to be removed, so far above the ultimate flowline as not to be disturbed, undermined or washed away, and that all such hubs or points be properly guarded and tied in to permanent structures. This also applies to bench marks which will be submerged or undermined by the rise of the water. All hubs and benches already above the flowline should be carefully preserved and removed from time to time as it becomes necessary.

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A few new triangulation stations should be established, the old ones which are liable to be of use should be renewed, new flag poles placed and the trees and brush around them kept cut down. The cost of this work does not amount to a great sum coming under regular maintenance accounts and done a little at a time in the year's work, but may mean considerable expense and trouble if the work is left to accumulate for several years, and more still if it is left undone.

Reservoir Slope Erosion

The second point is in regard to the action of wind and wave on the steep slopes and their consequent erosion. In the original stripping of the Wachusett Reservoir, rules were made for the guidance of engineers and inspectors. These rules were designed to allow for the action of waves in the full reservoir. For steep slopes the rules were as follows:

> Where the margin is along a steep sandy slope . . . it is expected that the shore will gradually take a 3 to 1 slope between Elev. 355 and 395, or between high and low water. Below 355 the final slope may be assumed as ½ to 1 and above 395 as 1 to 1. Sections of the natural slope should be taken by stadia or otherwise, plotted to convenient scale, and the assumed slopes, as above, drawn on these sections so as to give approximately equal areas above and below the intersection of the 3 to 1 slope with the natural slope. (See sketch A, Fig. 1.) Strip to intersection of 1 to 1 slope with natural surface.
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> In case of very steep slopes extending to a considerable elevation above high water and where it is probable that erosion will cause landslides extending to the top of the slope, it will be necessary to strip the entire slope. (Sketch C, Fig. 1.) Where it is necessary to strip to the top of the steep slopes the clearings should be carried back about 75 ft. beyond the top of such slope.

On the accompanying sections of two steep slopes are shown this original stripping point as located according to the above rules, and also the flowline and top of bank as actually existing in 1911, three years after the reservoir was first filled. The first section (Fig. 2) is of a bank on the north shore of the basin exposed only to south and east winds, while Fig. 3 is on the south shore and is exposed to northeast, north, northwest and west winds. In each of these cases, the bank had been eroded by wave action at its base, and had slid, necessitating much additional stripping. The second of these banks is still changing and it is anticipated that it will continue to do so for some time to come. The action of the wind as well as of the waves is very noticeable on this bank—a layer of sand several inches in depth having accumulated on the top of the bank and in the woods behind it. The ma-

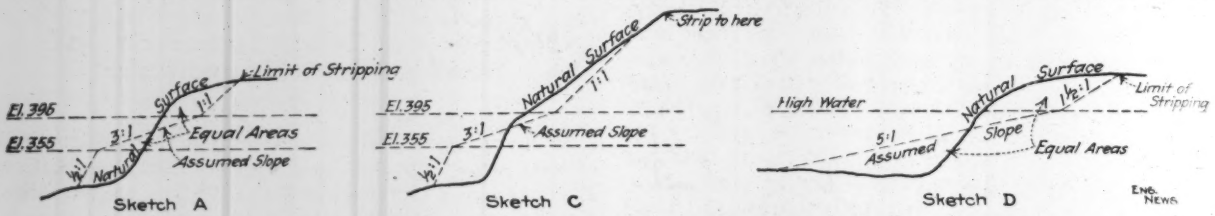


Fig. 1. Sketches Illustrating the Design of Steep Reservoir Banks

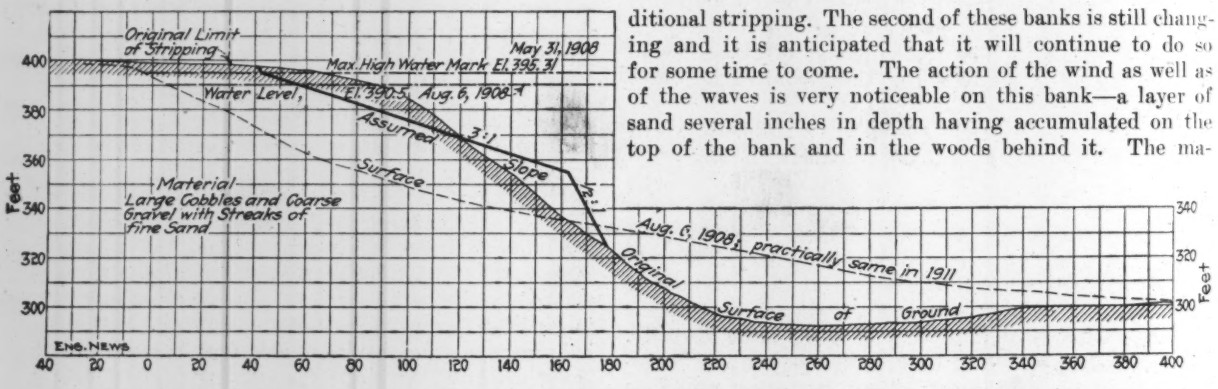


Fig. 2. Slope of North Shore of Wachusett Reservoir as Originally Stripped and after Having Been Filled Three Years

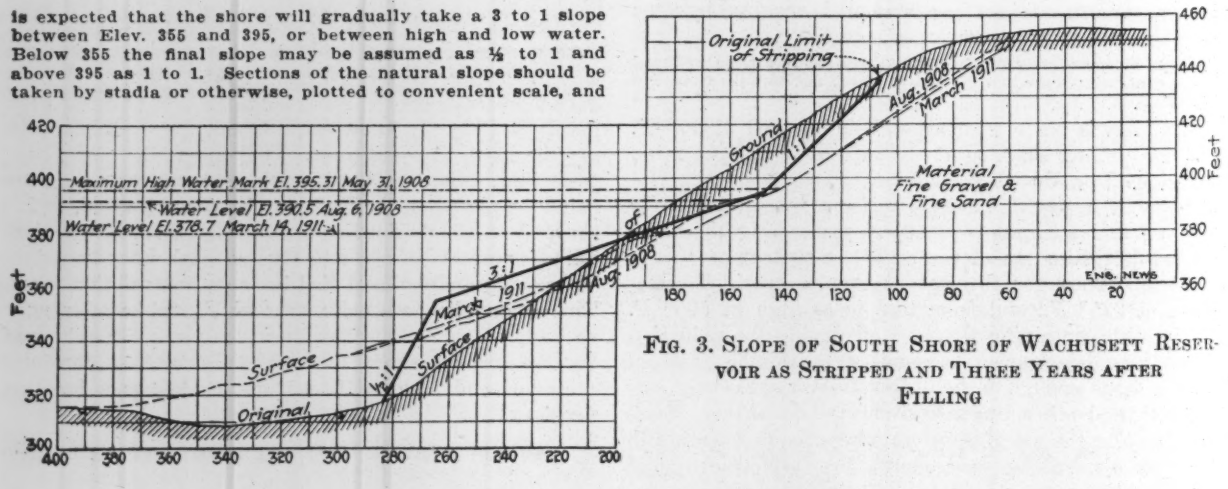
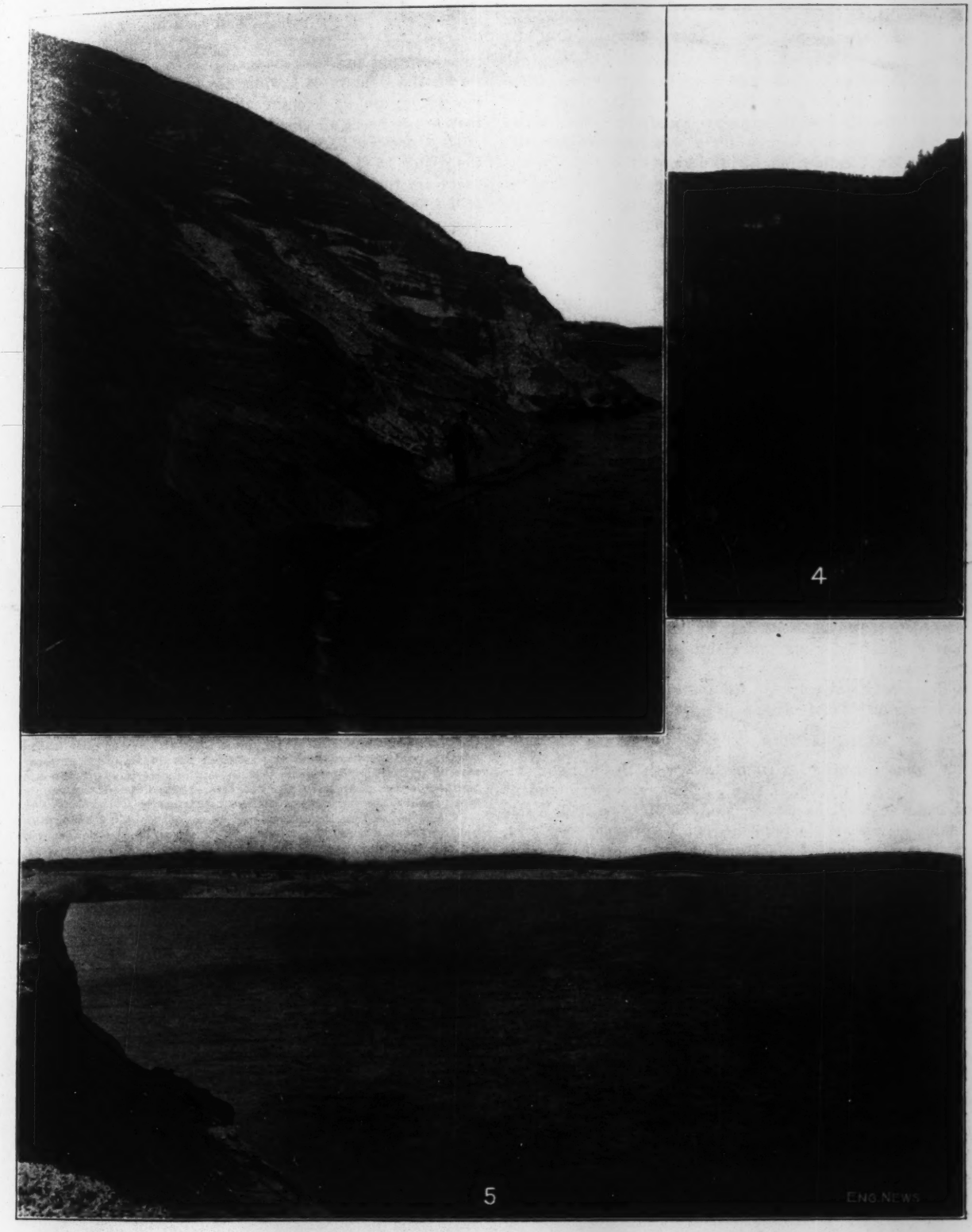


Fig. 3. Slope of South Shore of Wachusett Reservoir as Stripped and Three Years after Filling



(4) North bank in original condition; that is, before stripping or grading. (5) North bank, from another viewpoint, after having been subjected to high water; the water surface here shown is 45 ft. below high-water level. (6) Bank on south shore after high water. These views may well be compared with the profiles, Figs. 1 to 3, which show some of the original slopes, the stripped or graded slopes and the subsequent slopes after the reservoir had been filled and drawn down.

FIGS. 4 TO 6. VIEWS OF BANKS OF WACHUSETT RESERVOIR, SHOWING EFFECT OF WATER ON BANK SLOPES

terial in this bank is much finer and more compact than that in the first case.

This is a condition where the appearance of the original slopes was not such as to indicate that such great erosion would take place. The view, Fig. 4, shows the north bank before stripping (on the extreme right) and Fig. 5, the same bank after the high water of 1905, which was still 45 ft. below the flowline. Fig. 6 shows the bank on the south shore in 1904. Notice that the bank material in Fig. 6 is much finer than that shown in Fig. 5.

As a result of this experience it would seem that the ultimate slope attained by a coarse gravelly material containing many cobbles, acted upon by waves, will be between 2 to 1 and 5 to 1, the last probably being the permanent slope. As a modification of the diagram shown in Sketch *A* (Fig. 1), the writer would suggest that shown in Sketch *D*, substituting slopes of 5 to1, and 1½ to 1, for the slopes of 3 to 1 and 1 to 1 as shown in Sketch *A*, and omitting entirely the steeper slope of ½ to 1. Actual sections show that if there is a change of slope below low water it is even flatter than 5 to 1.

Shallow Flowage

Experience has shown that an area which is flooded only for a few months in a year and then for a depth of less than 5 ft., will grow up to goldenrod, sweet fern, blackberry vines, and small poplars, birches and alders, in a very short time, causing an unsightly and marshy appearance to the locality, which is undesirable in a public water-supply. Such conditions should be noted during construction and the work done at that time, as it is much more expensive for a small maintenance gang to do this work, than it would have been for the contractor's gang to do it, while at work on this part of the project, with his larger outfit of tools and men.

Reforestation of Drainage Areas

The last point is in connection with the work of reforestation. In 1909, E. R. B. Allardice, Superintendent of the Wachusett Department of the Metropolitan Water Board, in an article published in Engineering News, on "Reforestation of the Marginal Lands of the Wachusett Reservoir," stated: "Thus far, no serious fires have occurred, though several have started which would have caused great damage but for the effectual protection given."

In 1911, the reservation was visited by several serious fires. One, caused by sparks from a locomotive started on adjoining land, and spread by a moderate wind, swept a width of 2000 ft., over three, three-rod roads and over three 15-ft. interior forest roads, and was only stopped at a 60-ft. state highway by the combined efforts of about 25 men with hand extinguishers and shovels. If there had been no one there it would have jumped that obstacle as it had the earlier ones. This fire completely destroyed white pines 10 to 12 years old, averaging 12 to 15 ft. in height. Another fire, caused, presumably, by a cigar or cigarette butt carelessly thrown from a moving electric car, crossed two 15-ft. forest roads but was stopped at a 30-ft. highway. Both fires were on land formerly used for pasturage or cultivation and the pines were the tallest growth.

These two fires demonstrated the uselessness of a fire guard less than 30 ft. in width, at least. It is extremely doubtful if the second fire could have been stopped at the 30-ft. highway if the growth had been higher, as the fire-fighters could not have stood the heat. All the fires which have occurred and been overcome on this reservation have shown the wisdom of having fire guards (40 ft. is none too wide), and of keeping them mowed and cleared, if they are to be at all efficient as such.

It is not the desire or purpose of the writer to decry the use of 15-ft. interior roads. The more interior roads there are the more chances there are of limiting the fire to a small area, especially if it is discovered early in its career. They are also indispensable in getting into the reservation for the purpose of spraying for brown-tail and other caterpillars, hauling out wood from improvement clearings, and many other purposes. But it is his desire to emphasize the need of enough wider fire lines, kept mowed, to provide adequate and safe spaces in which to operate efficiently against a serious fire.

The Kansas City Street-Railway Franchise

The difficulties into which the Kansas City Street Ry. system had fallen and the attempt of the receivers and courts to secure a satisfactory reorganization based on an appraisal and a franchise scheme outlined by B. J. Arnold were noted in Engineering News of May 22, 1913, together with a summary of Mr. Arnold's work in the case. After long negotiations, a compromise franchise between the city and the railway company was evolved more or less along the lines of the Arnold suggestions, and this was approved at a municipal election on July 7, in spite of considerable opposition.

The New Franchise

LIFE TERM—The term is 30 years with provisions for forfeiture and purchase by the city before expiration under conditions which protect the capitalization. At termination the company has rights securing the allowed capitalization of that date. The city may thereafter make new arrangements with the old company, cause the purchase of the system by other interests, operate the system itself or require the present company to continue temporarily.

CAPITAL—The compromise figure of $25,649,000 is taken as the total value of property in Missouri to be represented by capital (plus extensions and betterments since May 1913.) Of the total $6,300,000 represents intangible items. The last named amount is to be amortized from surplus earnings divisible between city and company, with the intention that capitalization and tangible value may eventually be alike. (This amount is to be indirectly amortized by building extensions out of the city's share of surplus profit as noted below.).

The company is to provide each year such fresh capital as will, with its share of surplus profits, amount to from $650,000 at first to $925,000 at the end. Such sums will correspondingly increase the capitalization figures. However, if net earnings exceed or fall below 35% of gross receipts for any year the annual amounts to be provided above are to be correspondingly increased or diminished.

CONTROL—The city is to participate in control and management through representation on the board of directors and on a board of control. The latter will comprise one man appointed by the company, one man appointed by the city, and a third member in the event of differences of opinion. Salaries will be paid by the company. This board will have control of routes, schedules, character of equipment and construction, system of accounts, charges to capital, classification of expenditures, auditing, etc. The company and city may each remove its representative or may apply to the courts for removal, for cause, of the other party's representative.

There will be five directors acting for the city and six for the company. The former are to be appointed hereafter by the local Court of Appeals from lists furnished by the mayor. (Initial incumbents were selected at the recent franchise election.)

Under the board of control will be the general manager.

Per the board of control, P. J. Kealy has been selected by the company and Robert P. Wood (a consulting engineer) by the city and have been installed by the receivers. The name of the company has been changed to Kansas City Railways C

REHABILITATION—Up to $1,500,000 is to be spent at once on one viaduct line. For three years, five miles of single track per year are to be built in specified locations and 25 new cars per year added. The city will pay the cost of new tracks in Union Station plaza and retain title thereto. An additional $250,000 per year is to be spent for immediate extensions to be fixed by the board of control.

EXTENSIONS—After three years, the city, by ordinance, may require any extensions not proved manifestly unnecessary—up to four track miles per year. Any extensions must be made which the board of control finds will earn operating expenses and 6%.

DIVISION OF INCOME—A guaranteed cumulative earning of 6% on the agreed capitalization is provided. From the net income the following items are to be subtracted in order; (1) expenses of management, operation, maintenance and taxes, (2) 6% return, and (3) liabilities for injuries and damages. Any surplus then remaining is to be credited to the city but used by the company for additions and extensions, until $6,300,000 shall have been expended. After this point the surplus is to be credited two-thirds to the city and one-third to the company. Until ordained otherwise, the city part of divisible surplus profits is still to be used for additions or extensions or for reduction of capital, and to that extent the city acquires a right in the property. Use of city's share in extensions may not increase capital figures. When the city's right reaches one-half the total capitalization the city becomes the owner of the system but the company possesses then a lien on the property to secure its remaining share of the capitalization.

Under operating expenses, etc., noted above, an allowance is made for maintenance, repairs, renewals and depreciation at least 16% of the gross earnings of the previous year. For damage claims not less than 4% is to be allowed. With expenditures less than these allowances, the balance is to be credited against excesses of the following years.

FARE—A five-cent rate of fare for adults will be continued with universal transfers. There will be a half fare for children of 8 to 12 years. No passes are to be issued but employees, firemen and policemen ride free. However, the city may use its proportion of divisible excess profits for the reduction of fares, although it may not do this in such a way so as to materially reduce the amount of the company's share below a sum which the company would have received if the rate had not been reduced. (This evidently is intended to provide a certain stimulation of traffic with reduced fares to compensate for the unit reduction.)

INTERURBAN LINES, EXPRESS, ETC.—Connections with interurban lines continue as before and until changed by city ordinance on six-month notice. Such operating rights may be revoked by the city for cause. Interurban cars are to be operated in the city by city-company crews and new fares retained as on ordinary cars. For interurban connections, 15% of the amount received by interurban companies from passengers entering the city goes to the local company.

PUBLIC ACQUISITION—When the city secures right to half the system by application of its share of divisible profits, it becomes the owner, with the company holding a lien on the property for its former share. By paying the company cash for its share of ownership and by paying the cost of redeeming mortgage bonds (with 3% premium) the city may become sole owner. When the city secures half ownership as above the company loses all right to the divisible profits. Prior to this critical point the city may buy out the company by paying for capital, cost of redeeming bonds, and the value of right to participate in surplus profits.

Criticisms of the Franchise

The franchise was criticized before election on the ground that the compromise valuation included certain intangible elements which should have been omitted because they represented money lost in an admittedly speculative period of the road's development. The reasonableness of 5% was admitted by the opponents of the ordinance, but the 6% allowed was held in effect to increase the capitalization to $36,000,000.

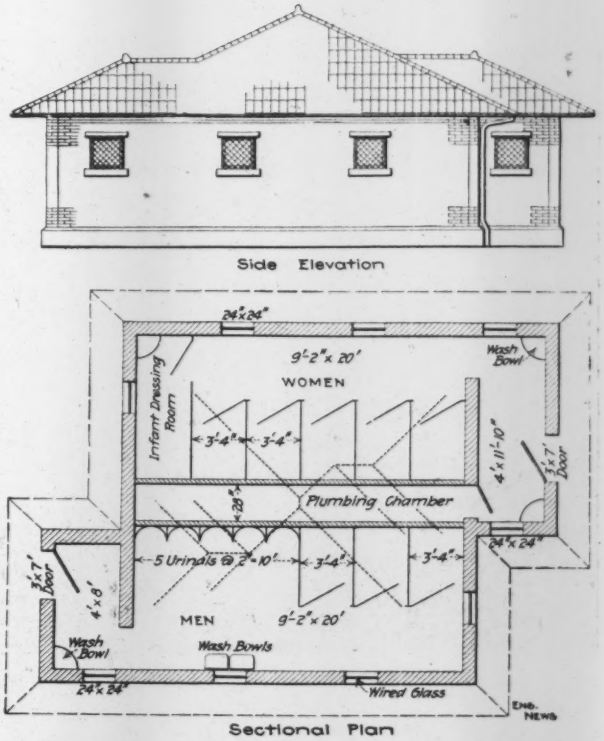
The scheme of dual control by company and city was claimed to violate every principle of good management and to tend to result in continual litigation.

Making the expenses of injuries and damages subordinate to the 6% preferential return on capitalization was attacked, it being held that these should not be separated from operating expenses, the first item to be subtracted from gross earnings.

The capitalization of betterments was criticised on the ground that the most careful maintenance and renewal will never bring the property much above Mr. Arnold's finding of 79% good-as-new.

A Public-Comfort Station with a New Feature

The plans herewith show a public-comfort station which will be built in the city of Youngstown, Ohio. The designs were made in the city engineer's office (F. M. Lillie, City Engineer; L. T. Fawcett, assistant engineer



Floor Plan and Side Elevation, Lincoln Park Public-Comfort Station, Youngstown, Ohio

in charge of the design). The plans show an arrangement similar to that used elsewhere, but with an interesting addition in the shape of an infant's dressing room, which is partitioned off from the women's compartment.

Brick walls, tile roof on wood roof-framing, a brick main dividing wall, and concrete floors, form the shell of the structure. The interior partitions will be of wood, as unfortunately the appropriation happens to be too small to provide slate or other fireproof partitions.

The design secures what is believed to be a structure of excellent appearance at a low cost. The cost is estimated at $2500, of which the plumbing makes up nearly $1000.

Recent Developments in Granite-Block Paving

SYNOPSIS—This article summarizes the evolution which has taken place in granite-block paving practice and gives the new specifications adopted by the Committee of Consulting Engineers of the City of New York for work during the current season. These specifications are the product of about four years' careful study, experiment and investigation, and present the latest practice of some of the most noted pavement experts in this country.

During the past four years an evolution has taken place in granite-block paving, indeed an evolution nearly as marked in practical results as that from the old cobblestone pavement to the first squared block pavements. The granite-block pavements now being laid in New York City, Philadelphia and other large cities, are nearly as smooth as brick, less than half as noisy as the best granite block laid five or more years ago, yet retaining all the advantages which make granite block best for heavily traveled city streets. Instead of large roughly shaped blocks, 7 in. or more in depth laid with seldom less than 1-in. joints filled with sand, smaller, carefully squared blocks, 5 in. deep and laid with not greater than ⅜-in. joints filled with a bituminous binder, now constitute first-class standard practice.

FIG. 1. VIEW OF LAFAYETTE ST., NEW YORK CITY, SHOWING EXAMPLE OF GRANITE-BLOCK PAVING UNDER NEW SPECIFICATIONS

Since a concrete foundation for first-class granite-block pavement has become universal practice the necessity for the larger-size blocks has disappeared. The blocks themselves instead of constituting the whole pavement are now made to serve as a wearing surface only, as with asphalt and wood block. The more accurately shaped blocks laid with much closer joints are the result of a determination by pavement experts that the additional expense of about $1 per sq.yd. for the pavement is justified by the improved wearing qualities, better appearance and other advantages obtained by the new specifications. The present cost of the new type in New York City varies from $4 to $4.75 per sq.yd., including a 6-in. concrete foundation.

The closer joints tend to eliminate the rounding off of the top edges of the blocks, which results in constantly widening the gap between blocks and making a rough noisy pavement, after a few years' service. The best practice is no longer to insist upon the hardest obtainable granites, but to use tough, medium-hard granite which will wear uniformly instead of those which experience has shown will acquire a polished hump in the center and rounded edges under severe traffic conditions.

Granite block, even that laid under the new specifications, is, of course, noisier under steel tire and horse-drawn traffic than either asphalt or wood block, and it is not so easy to clean; yet its slightly roughened surface gives a good foothold for horses' hoofs and in durability is and always will be superior to all other types of pavement; and it is the easiest to repair. It is always likely to remain the only satisfactory pavement for streets which carry a heavy trucking traffic.

During the past four years many thousands of square yards of new granite block have been used in repaving New York City streets. These have been laid under constantly improving specifications which have been redrawn and modified from time to time by conferences between the paving experts in and about New York City and the quarry men. Several inspection trips were made

by the city engineers through the various quarries in North Carolina, Massachusetts, New York, Maine, New Hampshire, where are the principal sources of granite paving blocks for New York City, in order to determine the probable output and to insure an understanding on the part of the quarry men of the requirements.

The granite-block pavements resulting from this study, country, they are of extraordinary interest and value to all municipal engineers. Of special interest are the sections relating to the joint filler; cement grout is not used; and the specifications here given for bituminous filler were especially prepared by Dr. Felix Keeberg, chemist of the Bureau of Highways of the Borough of Manhattan, after a careful study, for the purpose of mak-

FIG. 2. LAFAYETTE ST. PAVEMENT DURING CONSTRUCTION

care and experience are of a smoothness never before obtained. Fig. 1 shows a view of Lafayette St. near Pearl St., which is typical of these new pavements. Fig. 2 is the same pavement in the course of construction.

The final specifications for this class of work are essentially the joint product of the Committee of Consulting Engineers of the City of New York. In order to accelerate the present season's work in the Borough of Manhattan, some slight changes and additions were made in Committee's specifications, which may or may not be finally adopted by all the boroughs. As these new 1914 specifications present the experience, study and present practice of some of the best known paving experts in this

ing a comparative service test of the relative values of coal-tar and asphaltic paving cement.

It is stated by the Chief Engineer of the Bureau of Highways of the Borough of Manhattan that the method of preparing the joint filler as a mixture of paving cement and hot dry sand has not been formally adopted by the other Borough Engineers, but is introduced in the belief that a method successfully used abroad, and which has been experimentally used in this borough on repair work during the past year with entire satisfaction, will be an improvement on the previous method of first filling the joint partly full of sand and pouring paving cement on top of it. This latter method has resulted in a ten-

FIG. 3. OLD AND NEW GRANITE-BLOCK PAVING AT LAFAYETTE AND PEARL STS.; SHOWING CARE TAKEN TO SHAPE BLOCKS AROUND MANHOLE HEADS ON NEW PAVEMENT

dency toward the use of too much sand and too little paving cement.

The specified foundation is a 1:3:6 gravel or broken-stone concrete, 6 in. thick.

GRANITE-BLOCK PAVEMENT

SECT. 1. EXCAVATION AND FOUNDATION—The roadway shall be brought to a uniform subgrade, and shall be rolled with a steam roller until the surface is thoroughly compacted. Portions of the roadbed inaccessible to the steam

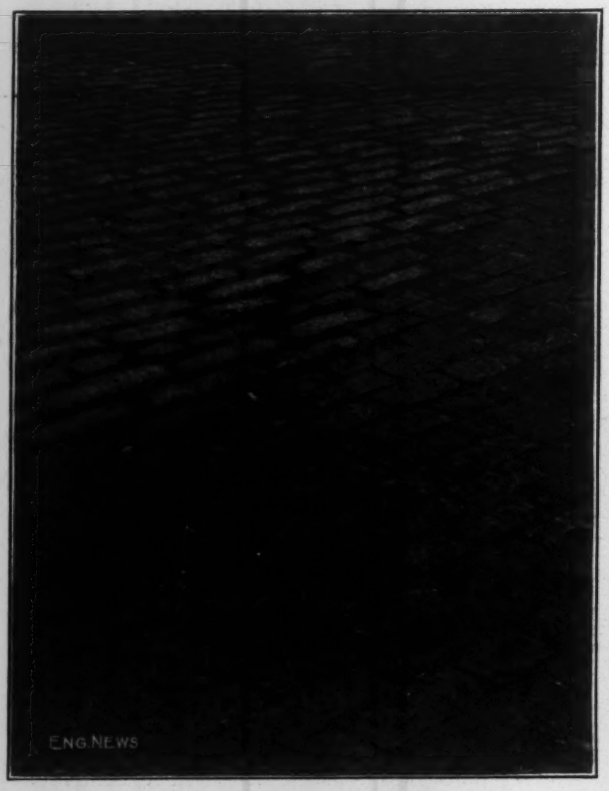


FIG. 4. OLD AND NEW GRANITE-BLOCK PAVING, LAFAYETTE AND PEARL STS.

roller shall be wetted and tamped or rolled with a small roller as may be directed.

Where the roadway subgrade consists of sand, rolling may be omitted, if permitted by the engineer. Material which cannot be satisfactorily rolled, or which is otherwise objectionable, shall if required be removed and replaced by good, wholesome earth. In shaping the roadway, great care shall be used to secure a uniform surface parallel to, and the required depth below the finished pavement surface.

CONCRETE FOUNDATION—On the subgrade thus prepared shall be laid the concrete foundation as specified. When the old pavement is on a concrete foundation, this foundation shall be swept clean and where necessary shall be thoroughly wet and brought to such crown and grade with new concrete as may be directed, or shall be removed and replaced with new concrete to such an extent as may be directed.

SECT. 2. GRANITE, QUALITY—The granite from which the blocks are cut shall be medium grained, showing uniform in quality and texture, without seams, scales or discolorations, indicating disintegration, an even distribution of constituent minerals, and free from an excess of mica or feldspar. No out-crop, soft, brittle or seamy stones will be accepted.

SECT. 3. DIMENSIONS—The size of the blocks shall be as follows: Not less than 6 in. or more than 10 in. long not less than 3½ in. or more than 4½ in. wide, and not less than 4¾ in. or more than 5¼ in. deep.

The contractor shall select a definite width of block to be used for each city block within the limits of this contract and notify the engineer of such selection. All blocks shall be of the selected width with an allowable variation of ¼ in. from this width, and within the limits for width of [illegible] specified above.

For use in street railway tracks the blocks may [illegible] maximum length of 11½ in., the other dimensions rem[illegible] the same as specified above.

When approved by the engineer the blocks may be o[illegible] other dimensions as special construction may make n[illegible] sary.

DRESSING—The blocks shall be approximately rect[illegible] lar on top and sides and uniform in thickness. They [illegible] be so cut that the joints between individual blocks [illegible] laid shall average not more than ⅜ in. The head of the [illegible] shall have no depression greater than ¼ in. from a str[illegible] edge laid in any direction and parallel to the general [illegible] face of the block.

HANDLING—Care shall be used in handling the blocks [illegible] that the edges and corners are not chipped or broken.

SECT. 4. SELECTION—The stones from each quarry shall be piled and laid separately in different sections of the work and in no case shall the product of different quarries be mixed.

SECT. 5. INSPECTION BEFORE DELIVERY—The paving blocks will be inspected at the quarry or at the dock as unloaded; and if the percentage of blocks failing to conform to these specifications found in 1000 blocks, as unloaded, shall exceed 15%, the whole cargo will be condemned and will not be used on the work.

If permitted by the engineer the percentage of unsatisfactory blocks may be determined from the examination of another 1000 blocks, but if this is permitted, before delivery

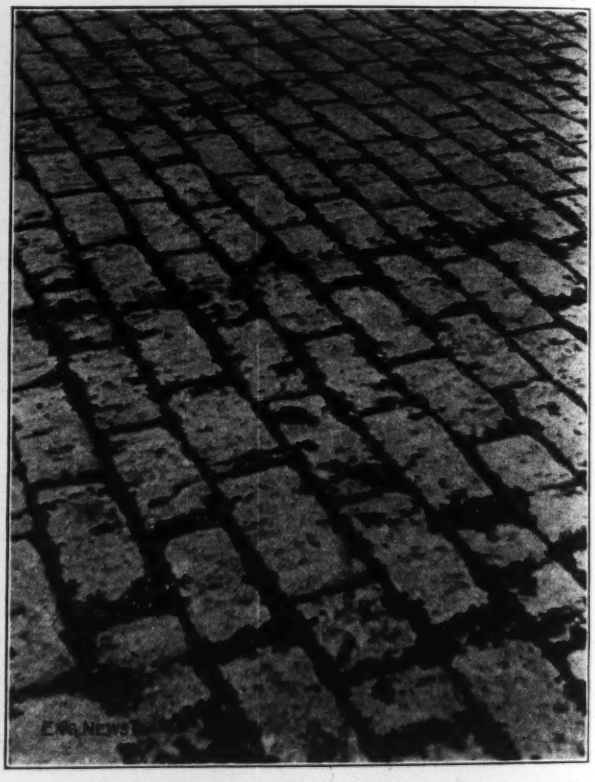


FIG. 5. GRANITE-BLOCK PAVEMENT IN FULTON ST., NEW YORK CITY, LAID IN 1912, WITH ½-IN. JOINTS—AN INTERMEDIATE STAGE IN THE DEVELOPMENT OF BETTER GRANITE-BLOCK PAVEMENTS

on the street the unsatisfactory portion of the cargo shall be removed and not delivered on the work.

Acceptance of a cargo as described will not be considered as acceptance of all individual blocks and the engineer and his assistants will have the right to reject any block on or in the work not conforming to the requirements of the contract.

SECT. 6. FOUNDATION CONCRETE SURFACE—The top of the concrete foundation shall be brought, by screeding or otherwise, to a grade which shall not vary from ¼ in. at

any point from a surface parallel to and 6 in. below the finished surface of the pavement.

SECT. 7. SAND BED—On this concrete shall be laid a bed of clean, coarse sand, free from gravel, over ⅜ in. in diameter. The bed shall not exceed 1 in. in thickness and be sufficient to bring the surface of the pavement, when thoroughly rammed, to the proper grade.

SECT. 8. LAYING BLOCKS—Upon this bed the blocks shall be laid in straight courses from curb to curb and at right angles to the lines of the street, except when otherwise directed by the engineer. The grade and crown shall be as shown on the plan or as directed. End joints shall be broken by a lap of at least 3 in., and adjoining stones in the same course shall not vary more than ¼ in. in width. The blocks shall be set in contact at end joints and with side joints as nearly uniform as practicable and averaging not more than ⅜ in. between individual stones.

Guide blocks or head stones shall be set at such intervals as directed by the engineer.

SECT. 9. RAMMING AND ADJUSTING—After the blocks are laid they shall be rammed to a solid bearing, any low blocks being taken out by means of tongs and raised by adding sand to the bed, and the whole rammed again to a fair and even surface. No sand shall be placed in the joints, but, if permitted by the engineer, a small quantity of clean, dry sidewalk grit may be put into the joints, in amount only sufficient to pin the blocks and prevent them from rocking. The joints shall be adjusted and unsatisfactory blocks taken out with tongs. No pinch bars shall be used except by special permission of the engineer. No sand shall be placed in the joint except when mixed with bituminous filler as specified hereafter.

A sufficient number of rammers shall be employed so that all pavement laid may be rammed and joints filled before work ceases each day.

SECT. 10. JOINT FILLER—The joint filler used shall be a mixture of paving cement, described hereafter, and hot dry sand in the proportion of 1 part sand to 1 part paving cement by volume, or as much sand up to that proportion as the paving cement will carry. The sand shall be clean and sharp, and all of it shall pass a 10-mesh screen. It shall be thoroughly mixed with the paving cement by stirring or otherwise.

The mixture shall be poured into the joints until they are full and remain full, repouring being done if necessary so that they shall remain permanently filled flush with the surface of the pavement.

SECT. 11. COAL TAR PAVING CEMENT—The coal tar paving cement shall be a straight run residue obtained from the distillation of coal tar and shall comply with the following requirements:

(a) Melting point shall be not lower than 110° F. nor higher than 125° F.

(b) Free carbon shall not be less than 20% nor more than 35%.

(c) Specific gravity at 77° F. shall not be less than 1.22 nor more than 1.30.

(d) Specific gravity of the distillate to 670° F. shall not be less than 1.06 at 140° F. compared with water at the same temperature.

FIG. 6. PILE OF OLD-STYLE GRANITE BLOCKS

FIGS. 7 AND 8. NEW GRANITE BLOCKS, JANE ST., NEW YORK CITY; ILLUSTRATING MORE REGULAR AND UNIFORMLY SHAPED BLOCKS REQUIRED BY NEW SPECIFICATIONS

The contractor before beginning work on any contract shall obtain from the engineer a statement in writing as to the melting points desired for that particular contract and a variation of 5° F. either way will be permitted from this melting point, but within the limits as indicated above.

SECT. 12. THERMOMETERS IN KETTLES—The kettles in which the coal tar paving cement is heated on the street shall be equipped with approved thermometers and the paving cement shall be heated to a temperature of not less than 250° F. nor more than 300° F. and shall be poured when between these limits.

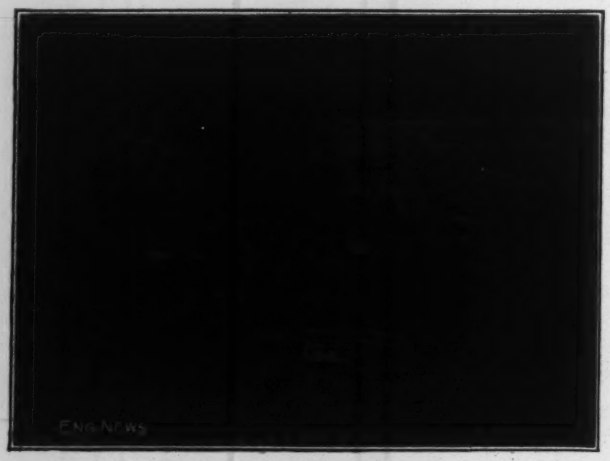


FIG. 9. DIFFERENCE BETWEEN OLD- AND MODERN-DRESSED GRANITE-BLOCK PAVEMENTS ON MARKET ST., PHILADELPHIA, PENN.

SECT. 13. ASPHALTIC PAVING CEMENT—The asphaltic paving cement shall be obtained by the distillation of an asphaltic petroleum at a temperature not exceeding 700° F., and shall comply with the following requirements:

(a) It shall be homogeneous.

(b) Melting point shall not be less than 130° F. nor more than 145° F.

(c) Solubility in carbon tetrachloride shall not be less than 98½%.

(d) Penetration at 77° F. shall not be less than 60 nor more than 100, the penetration test being made with a No. 2 needle for five seconds under a load of 100 grams, and the penetration at 100° F. shall not exceed three times the penetration at 77° F., the condition of time and load being as above established. The contractor before beginning work shall obtain from the engineer a statement in writing as to the penetration desired for any particular contract and a variation of not greater than ten points either way from this penetration will be permitted.

(e) Ductility at 77° F. shall not be less than 40 cm. at the penetration called for.

(f) It shall not lose more than 3% by volatilization when maintained at a temperature of 325° F. for five hours, nor shall the penetration of the residue, after such heating, be less than one-half the original penetration.

SECT. 14. THERMOMETERS IN KETTLES—The kettles in which the asphaltic paving cement is heated on the street shall be equipped with approved thermometers and the paving cement shall be heated to a temperature of not less than 275° F. nor more than 350° F., and shall be poured when between these limits.

SECT. 15. All tests will be made in accordance with the Borough Presidents' Standard Methods of Tests on file in the office of the engineer.

SECT. 16. HEATING APPLIANCES—The appliances for heating the materials for filling the joints shall be of such efficiency and numbers as will permit the pourers to follow closely the rammers, and all joints of rammed pavement shall be poured with the filler before the cessation of work for the day.

SECT. 17. NO TRAFFIC BEFORE POURING—No traffic of any description shall be permitted on the pavement until the joints have been completely filled with the bituminous filler as described, and it has had time to harden.

SECT. 18. MORTAR UNDER RAIL HEAD—When there are car tracks in the street the spaces between the web of the rail and the paving blocks and directly under the head of the rail shall be filled with a stiff mortar, composed of 1 part of portland cement and 3 parts of clean sharp sand. This mortar shall be carefully struck so that it will not project beyond the vertical plane of the edge of the rail head, and it shall be kept in position until the paving has been laid. This mortar furnished and placed will be paid for at the price bid for concrete within the railroad area.

SECT. 19. REPAIRS AND RESTORATIONS—In making repairs to the pavement, or restoring the pavement over openings, the materials used shall conform in all respects to the requirements for the original pavement. The adjoining pavement and foundation and so much of the earth under the foundation as may be necessary and directed shall be removed by the contractor for the proper restoration and repair of the pavement. The concrete base shall be removed for a distance of 6 in. beyond the extreme limits of the area of earth disturbed. All joint surfaces of concrete shall be cleaned and coated with portland cement grout, and the wearing surface of the pavement shall be replaced over an area extending at least 3 in. on all sides beyond the area of the new concrete, all courses being toothed or racked back.

The price for restoring the pavement shall include the cost of all materials and labor necessary to properly complete the work as described above, and the maintaining of the same during the remainder of the period of maintenance.

SECT. 20. CONTRACT PRICE TO INCLUDE—The price bid for granite paving shall include the cost of all materials and labor necessary to furnish and lay the granite paving complete, and the cost of adjusting and bringing to the new lines and grades such curb and flagging and abutting pavements as may be deemed necessary by the engineer, except as otherwise provided, and maintaining the pavement for one year.

FIG. 10. LAYING A "NIDGED" GRANITE-BLOCK PAVEMENT IN GLASGOW, SCOTLAND

(From a photograph taken in July, 1913, by Geo. W. Tillson, Consulting Engineer, Borough of Brooklyn, New York City.)

The excellent results obtained under these specifications in the Borough of Manhattan, New York City, are no less due to the better quality of materials used than to the more rigid and efficient inspection system developed under the administration of the present Chief Engineer of Highways, H. W. Durham.

Inspectors are instructed to select blocks of uniform width and depth for each course and to see that each block

is laid on a full bed of sand and struck in at the base so as to bring the stone in contact with its neighbors in the preceding course, which insures the closest possible joint. The inspectors are also instructed to see that the joints in the line of traffic are close and that the alignment of the courses is true. The operation of ramming is not permitted to approach within 20 ft. of the paving. After ramming, the pavement is backrammed whenever the surface looks uneven.

Under the new Pittsburgh, Penn., specifications recently put into effect, new stone-block pavements are laid with blocks from 5 to 5½ in. in depth, on a sand cushion 1½ to 2 in. thick, and with joints filled either cement grout or bituminous material. The total thickness of the completed pavement including 6 in. concrete base is to be not less than 13 in.

During the last year the first pavement of this type was put down in Philadelphia on Market St., and W. H. Connell, Chief of the Bureau of Highways, in his recent report has this to say regarding the new pavement: "The new type of granite block forms a pavement almost as smooth and easily cleaned as asphalt, yet sufficiently durable to withstand the wear of heavy traffic."

In Great Britain, paving engineers have occasionally gone even further in specifying regularly shaped blocks. The accompanying illustration, Fig. 10, is from a photograph taken in Glasgow, Scotland, in July, 1913, by George W. Tillson, Consulting Engineer of the Borough of Brooklyn, New York City, who gives the following explanation:

"The blocks were what they called nidged, that is, they were dressed. As a matter of fact, as can be partially seen in the picture, the blocks were dressed on all sides but the bottom, and fine axed on the top. The pavement was the best I have ever seen, but cost $6.25 per sq.yd. It was located on a street-car street and replaced an asphalt pavement which had been down for about ten years."

A Notable Decrease in Electric-Railway Traffic Resulting from Increased Fare

In December, 1911, the Hudson & Manhattan R.R., which operates two pairs of electric-railway tunnels between New York City and New Jersey communities, raised the fare on the northerly, or uptown, tube from five to seven cents. The changes in traffic resulting from this move are reflected in the traffic figures regularly reported to the Public Service Commission for the First District of the State of New York and published in its regular reports.

Ticket sales at stations on the northerly line in question uniformly showed a marked decrease for each month in 1912 compared with a corresponding period for the year before, and this decrease continued, though perhaps not quite so markedly, during 1913. For 1912 the general decrease of 17.6% (15,723,000 to 12,956,000) is to be compared with an increase of 22.8% for 1911. For 1913 the uptown traffic dropped to 12,295,000, a further loss of 5.8% from the 1912 figures.

The southerly, or downtown, tubes showed an increase of 28.2% for 1912 (12,090,000 to 15,498,000), compared with 9.5% increase in 1911 over 1910. Much of this, however (the rise from 216,900 to 4,020,000), was due to joint-line operation over the Pennsylvania R.R. to Newark. Deduction of joint-line tickets results in a decrease of 2.9% for 1912 in place of an increase of 6.6% for 1911. For the calendar year 1913, the total downtown traffic was 22,430,000, an increase of 44.7%. Of this, 5,568,000 was due to joint-line tickets, and the strictly tube traffic was 16,861,000, an increase of 47.4%.

It is seen, therefore, that the slump in regard to the downtown tube was only temporary and is not easily explained; but it may be assumed that the trouble on the uptown line was due to the reluctance of patrons to pay the 40% rise in fare, so long as there existed reasonable ferry and surface lines.

In the 1912 report of the Public Service Commission there is an interesting estimate of the probable loss of revenue to the company from this move, which evidently has proved unwise. It should be noted, however, that the increase in fare was not in any sense an extortion, or even unfair, as the company's lines were of very heavy first cost and their operation under a five-cent fare was giving deficits.

The added revenue for 1912 from two-cent tickets was $509,390 (17½%), and the total number of passengers carried would have yielded at five cents a gross income of $2,903,962, but the drop in passengers carried one way meant a loss, at the old rate, in round-trip fares of $276,730, not considering the normal increase in traffic manifest between 1910 and 1911 (23%). If a prospective increase as low as 15% were killed off by the new fare, then $235,850 in round-trip fares were lost to gross revenue. This added to the above $276,730 gives a probable minimum loss of $512,580 to be compared with $509,390 actual gain shown.

For 1913 the further drop of 661,000 passengers going one way meant a direct loss of $342,800 over 1911, at five-cent fares and round trips. If there would have been an increase of as little as 15% in traffic per year under the old rate, the number of passengers further lost in the second year would have risen to 4,717,000, which means a total probable annual loss of $814,500, to be set off against the $459,000 actual gain in gross revenue for 1913 over 1911 through the seven-cent fare.

In its further discussion of this situation, the Public Service Commission holds that the operating expenses of the Hudson & Manhattan R.R.—16.5c. per car mile—are too high for a rapid-transit road, yet for 1913 this has gone up to 17.1c. The corresponding figures for the subway are 10.1c. and 10.1c., respectively. The operating costs per passenger in 1912 and 1913 were 2.16c. and 2.31c.; on the subway these figures were 2.15c. for both years. The passengers per mile of track (3,500,000 in 1912, 3,494,000 in 1913) is high, but below the New York City subway (4,130,000 and 4,290,000). On account of short lengths of haul, the Hudson & Manhattan passengers per car mile is higher, 7.6 in 1912 and 7.4 in 1913, compared with 4.7 and 5.1 for the subway. The car hours per mile of track, 26,471 in 1912 and 24,045 in 1913, is held to be low compared with 45,430 and 46,300 for the subway. From such figures it is argued by the Commission that the company should have aimed to increase the density of its traffic rather than the yield per passenger. The short haul, compared with that of the subway, it is urged, allows, without overcrowding, a very dense traffic—as great as 7,000,000 passengers per track mile per year.

The Southern Alberta Land Co. Irrigation Project

By W. St. J. Miller*

SYNOPSIS—An extensive irrigation system near Medicine Hat, Alta., is described. There will be a composite earth and concrete dam and a concrete intake on the Bow River, a 44-mile canal leading to a large storage reservoir formed by several dams, some 45 miles more of main canal and a large mileage of laterals. About 200,000 acres will eventually be under water.

An irrigation system designed to cover 200,000 acres of land is being constructed by the Southern Alberta Land Co., Ltd. The project lies between Medicine Hat and Calgary and to the southward of the large irrigation system of the Canadian Pacific Ry. (see the two maps, Figs. 1 and 7 for outline and general location of the system).

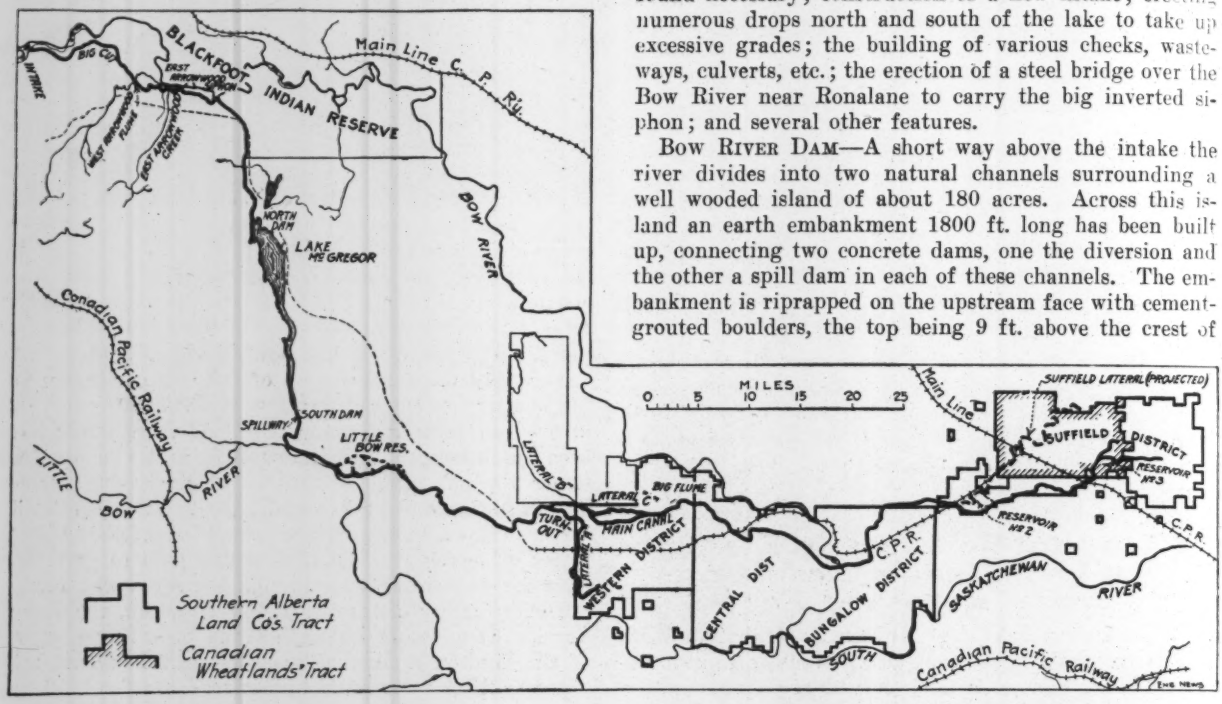


FIG. 1. GENERAL MAP OF IRRIGATION PROJECT OF THE SOUTHERN ALBERTA LAND CO.

Altogether the company owns or holds options on 400,000 acres of land, of which 1 in 4 must be irrigated under government requirements. Work was begun in 1909 but thus far only a few laterals have been excavated. These will be extended in 1913 so as to make possible the irrigation of 30,000 acres. The laterals will be extended as demanded.

Construction under the recently appointed Chief Engineer, D. W. Hays, was carried on vigorously during 1913. As in many similar projects, the work necessarily covers an extensive area, requiring extremely skillful executive ability, and here we evidently find the right man in the right place.†

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Elements of the System

The main canal from the intake to Lake McGregor Reservoir is some 44 miles long; the lake itself has a length of 21 miles, and from the South Dam of the lake to the western boundary of the company's tract is a stretch of about 45 miles.

Recent operations have consisted chiefly in enlarging the original canals to care for the increased capacity found necessary; construction of a new intake; erecting numerous drops north and south of the lake to take up excessive grades; the building of various checks, waste-ways, culverts, etc.; the erection of a steel bridge over the Bow River near Ronalane to carry the big inverted siphon; and several other features.

Bow River Dam—A short way above the intake the river divides into two natural channels surrounding a well wooded island of about 180 acres. Across this island an earth embankment 1800 ft. long has been built up, connecting two concrete dams, one the diversion and the other a spill dam in each of these channels. The embankment is riprapped on the upstream face with cement-grouted boulders, the top being 9 ft. above the crest of the dams. These two dams are a necessity in order to sufficiently raise the surface of the water in the river to pass into the main intake supplying the canal system.

Intake—The intake structure for the diversion of the necessary amount of water from the Bow River, not far from Gleichen, is nearing completion under the supervision of Division Engineer F. A. Wallace. This is entirely of concrete, having a floor width of 53½ ft., and total length of 206 ft. Of the total length, 123 ft. are above and 83 ft. below the gates. There are four gates, each 10 ft. wide by 8 ft. high, of the "Stoney" type, sim-

†The head office of the company is in the city of Medicine Hat, Alta., where a large staff of engineers, accountants, etc. is employed. The home office is at Princes St., London, England. R. G. Kennedy, of Vancouver, B. C., late Chief of the Department of Irrigation Works in India, is Consulting Engineer in Canada, and J. S. Beresford acts in the capacity of engineering and technical adviser to the London office. Louis C. Hill, of Los Angeles, Calif., has recently been engaged as consulting engineer.

similar to those in the Assuan Dam in Egypt. On the south side, 27 ft. above the gates, is the turnout leading the water to the main canal feeding the entire system. This inlet is 64 ft. wide and 50 ft. in length, consisting of five arched openings 10 ft. in width and 16 ft. long, with a roadway on top. The supply is regulated from a platform by the removal or addition of wooden "needles" resting inclined against horizontal I-beams spanning the five openings (Fig. 2).

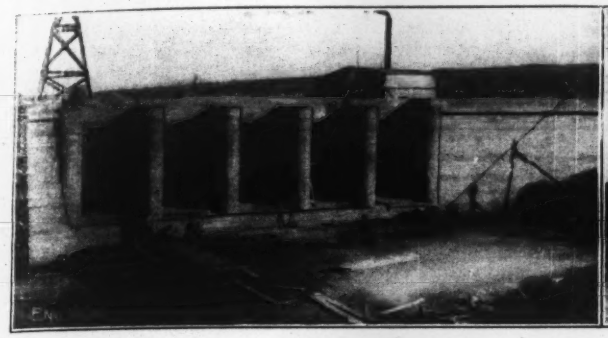


FIG. 2. HEADGATES OF MAIN IRRIGATION CANAL

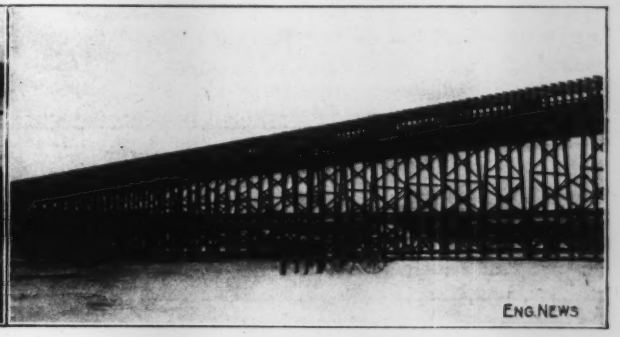


FIG. 3. WEST ARROWOOD FLUME

The walls throughout the intake are step-battered on the outside and partly straight, partly step-battered on the inner or water side. The floor is entirely of boulder concrete except a length of 25 ft. at the piers and abutments for the gates where it is topped with a layer of hammer-dressed boulders. The floor slopes above the gates 1:50 and below the gates 1:20. A 10-in. I-beam acts as a sill on which the gates will rest. A peculiar feature of the "Stoney" gates is that the water-tight joint is on the upstream or pressure side of the gates instead of the downstream side, as is more usual. Close contact is assured by the wedging action of a system of rollers.

DEEP CUT—About five miles southwest of the intake the canal emerges from the river valley toward a high plateau, which necessitated a very deep cut varying from 64 ft. to about 40 ft. over a distance of 8700 ft. The cut in this section was a source of much trouble and annoyance to the contractors on account of the nature of the ground, which consists principally of gumbo with numerous sand pockets and springs, causing frequent slides.

FLUMES—The next features are the flumes spanning several wide creek-beds. These are of wooden construction, carried on trestles with four-post bents 16 ft. c. to c., of a maximum height of 52 ft. The flume across the West Arrowwood Creek (Fig. 3) is 1200 ft. in length, of rectangular section, 16 ft. by 10 ft.

FIG. 4. EAST ARROWWOOD SIPHON

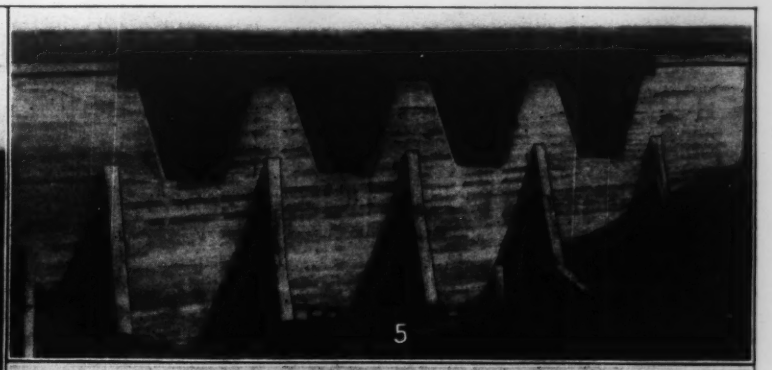


FIG. 5. NOTCH TYPE OF DROP

FIG. 6. FLASHBOARD-WIER TYPE OF DROP

INVERTED SIPHONS—The East Arrowwood Creek is spanned by a pair of inverted siphons of wood-stave construction, each 7½ ft. in diameter (Fig. 4). These con-

nect with concrete portals at each end. Between here and the lake are two more box flumes besides a wasteway and three large concrete drops.

LAKE MC GREGOR RESERVOIR—At the northeast corner of the lake is a dam 3600 ft. long on the crest, and 48 ft. high, containing some 325,000 cu.yd. of earth. At present, it has not been decided what form of structure will be necessary to deliver the water from the main canal to the lake reservoir. This reservoir, known as the Lake Mc Gregor Reservoir, is formed in a naturally dry coulee, 21 miles long, and at the widest part about 12,000 ft. across. Toward the southern end, the reservoir narrows down to a few thousand feet between precipitous banks. The capacity of the reservoir will be somewhere in the neighborhood of 300,000 acre-ft. There will be a concrete structure at the southern or outlet end, east and west of which will extend the existing earth dam,

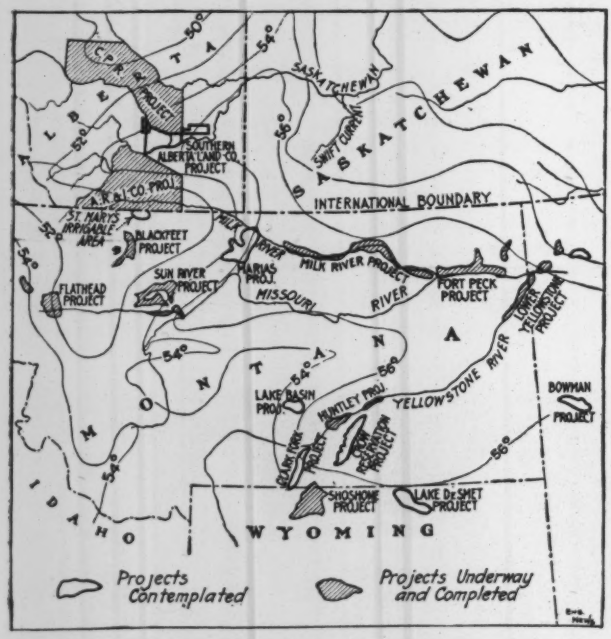


FIG. 7. ISOTHERMIC MAP OF VARIOUS IRRIGATION PROJECTS IN ALBERTA, MONTANA AND WYOMING

faced with boulder concrete from the toe to the water level on the upstream face, only. This dam is 2100 ft. long on the crest, 40 ft. high and 25 ft. wide on the top. At the downstream toe a gravel-covered rock-filled drain is being placed to provide a drainage system for the dam.

MAIN CANAL AND CANAL STRUCTURES—The velocity in the main canal throughout the system will vary considerably, depending on the nature of the material. An average velocity of 2.7 lin.ft. per sec. on natural earth to as high as 10 sec.-ft. in flumes or concrete sections will probably be the range.

Leaving the South Dam there is a stretch of ten miles of canal to the proposed Little Bow Reservoir, which will have a capacity of approximately 30,000 acre-ft. From here, the water will pass through an outlet structure, thence over several concrete drops to the turnout leading to the Alberta Land Company's tract.

One of these drops is shown in Fig. 5, which gives an idea of the size of these important structures. This particular one is of the "notch" type. The walls and floor are heavily reinforced. Concrete is mixed 1 part cement to 7 of sand and gravel, 5-in. boulders being used in the foundations and 2½-in. boulders in the walls. The following quantities were required:

Concrete	275 cu.yd.
Steel	15.7 tons
Forms	11,000 ft. b.m.
Paving	850 sq.yd.
Excavation	700 cu.yd.
Back-fill	2900 cu.yd.

Such a drop would take about three months to build complete. Another drop of the flash-board weir type is shown in Fig. 6.

From the before-mentioned turnout the main canal crosses the company's own holdings as far as Suffield and beyond. In this section, the main features of interest are the so called "Big" or "Mile-wide-valley" flume already constructed. This is 5000 ft. long with a 16x8-ft. box, approximately 30 ft. high. A wood-stave siphon, 8 ft. in diameter, which will be 6540 ft. in length, will carry the water originally coming from the Bow River across the same river. The steel bridge to carry this siphon has six spans of 120 ft. each, resting on concrete piers. This was supplied by the Wisconsin Bridge Co., and is designed to carry highway traffic also.

This is the last of the bigger structures on the project. All that is required to be done from here to the Suffield District is the extension of the present system of laterals from the main canal as necessity requires.

A noticeable feature in this project is the part that reinforced concrete is playing. With the exception of the flumes and wood-stave pipes, all the structures are of this solid construction. In no case will the water be permitted to exceed a maximum depth of 8 ft. in canals.

As already mentioned, this description must be incomplete at the present stage of development. It, however, covers what has already been done in this important scheme to date; also the work that is under way and at present projected for completion. It will convey some idea of the size of the undertaking, and the great expense attached to a development of this character. Something like 2,000,000 cu.yd. of dirt had to be removed in the Big Cut alone, and as many as seven hundred men have been on the payroll at one time.

Division Engineer C. E. Bee has charge of all the work on the Little Bow Division, and J. E. Lloyd and H. C. Bender on the remaining two divisions, covering the Western, Central and Suffield districts.

COMPARATIVE TEMPERATURE, RAINFALL AND DUTY-OF-WATER DATA

Some interesting computations have just been completed to determine the economic duty of water required by the farmers in this section during the irrigating season. The irrigation factor and losses in seepage and evaporation become matters of great importance in planning a system for irrigation, and it was to assist in the attainment of this necessary information that the following data were compiled.

A search was made through the statistical records of the meteorological and climatological services of Canada and the United States as far back as 1885. From these records were tabulated the yearly mean temperatures per month during the growing season, in this particular case taken from April to October inclusive. The average of these mean temperatures extending over as many years as were recorded was then obtained. In this way, a fairly

reliable mean temperature for the seven months was found for every recording station in the three Western Provinces, British Columbia, Alberta and Saskatchewan, as well as many places in Montana and Wyoming. The locations of these particular stations with their temperatures were platted on a map on which were also shown the various irrigation projects in the Northwest (see Fig. 7). By means of interpolation, isothermic lines were projected for the various degrees, from which result useful comparisons can be made.

By a similar method, a map has been compiled showing the total amount of precipitation over the same period of seven months. This total for each town is an average of the total rainfalls extending over as many complete years as it was possible to obtain. Isoplethic lines were interpolated in exactly the same manner as was done for the isotherms.

These maps prove very useful in many ways, particularly in showing relative characteristic conditions of this country as compared with those of the northern part of the United States where irrigation projects are extensively developed. The maps also assist in determining the quantity of water required for irrigation. In certain Montana projects, a limit of 3 acre-ft. was agreed upon in the first place which has since been reduced to 2 acre-ft., and it is now conceded in the northern States that 1½ acre-ft. would be an adequate amount for proper irrigation.

A particular advantage in extensive irrigation systems where water passes slowly through many miles of main canal and lateral irrigation ditches, with the water exposed to the bright sun of long summer days, is in the amount of heat absorbed by the water. Aside from the question of applying water to a thirsty soil, its warm temperature materially aids the luxuriant growth of products of the land not otherwise attained.

Track Layouts for Industrial Plants

The design of the track layout and sidewalk connections of industrial and manufacturing plants is a matter which should be entrusted to the engineer more largely than is generally the case, but in many cases the engineer is called in simply to stake out tracks according to a prearranged plan which in many cases might be modified with advantage to the convenient and economical working of the plant.

In a paper on "Economical Design of Factory Buildings," read before the Civil Engineers Society of St. Paul, W. E. King (Secretary of the Toltz Engineering Co.) referred incidentally to the desirability of the proper study of the sidetrack requirements. This paper is published in the June number the *Journal* of the Association of Engineering Societies (St. Louis, Mo.), and is followed by a discussion on the particular point noted above by George H. Herrold (St. Paul). An abstract of this part of the paper and the discussion is given below:

Mr. King—The track should be long enough to hold as many 40-ft. cars as the factory will need to load and unload in any one day. In isolated places, where the cars are not set so often, it must be long enough to allow for all the unloading and loading between each setting by the switch engine. Sidetracks for loading and unloading should be level. The rules of the railway, of the state and interstate railway commissions, and the state labor laws, are determining factors in the amount of room required for sidetracks.

Plans of the proposed sidetrack connection should be submitted to the railway, and assurance obtained that it is willing to put in the desired connection. If the sidetrack must cross the public road it is well to make sure of the necessary permit before putting money into the lot.

Mr. Herrold—One of the problems in connection with factory construction is trackage. It has fallen to my lot in several instances to design a track layout for factory and industrial enterprises, and I have been impressed with the fact in many cases that neither the architect, engineer nor owner had given the matter of trackage any thought, relying on the supposition that after the land had been purchased and the building was up the tracks could be got to it in some way. This is a serious oversight, as an important factor in the success of an industry is the quick and economical handling of the raw material to the factory and the finished product away from it.

In designing such trackage the engineer must not only be familiar with the daily car requirements of the factory, but also with railway switching methods in general and the particular switching services which can be obtained from the company which will handle the cars. It would be exceptional conditions which would permit of more than two switches per day; one in the morning to place the cars and one in the afternoon to remove them. Railway companies do not have switch engines waiting to place a car or remove a load whenever desired.

My experience leads me to believe that designers of factories have little conception of permissible grades or curvature for practical switching. Their plans often result in requiring additional land for right-of-way and a longer track than necessary, and even the building of trestle work or the making of excessive fills in order to bring the track to the factory at the proper level and give the length of track along the factory which should be level to permit shifting of cars during the day by hand.

The common factory switch costs approximately $185 in place; track, 82c. per running foot; low trestles, $9 per running foot, and grading for the roadbed about 20 to 50c. per running foot, per foot of fill. These items of cost and the running maintenance should be taken into consideration. Then there will be monthly bills from the railway for patrol and track repairs, even on the factory's own track, if the railway company is to operate its switch engines over it.

The simplest trackage possible is one switch and a stub-track running along the factory. This may serve the purpose for small outputs, but in general a double-end track is more desirable, as it facilitates the handling of the cars. No switching can be done on a stub track without disturbing all the cars, and this will stop the loading and unloading of the cars at the factory during the switching operations. With a double-end track, cars can be set in from one end and taken away from the other. If the business requires a different class of cars for the finished product than for the raw material, then the empties and loads can be placed at the factory doors in the morning, in the order required, and the loads and empties removed from the other end of the track in the afternoon without disturbing any cars not yet unloaded or being loaded.

Where the business is large enough, two more tracks are preferable. One track should run on each side of the factory; one for raw material loads only and the other for loading and out-going loads only. In general, each track should have a car capacity (between the clearance point of switches) equal to twice the number of cars to set on it. This permits the moving of the entire string of cars past the factory by hand, using a pinch-bar or car-puller between regular switching. A factory of this size should be designed to begin its processes on one side of the factory and deliver the finished product on the other side ready to be loaded into the cars in order to eliminate cross handling.

Track scales and track must be considered. Scales should always be under cover, and where possible on a separate track from the loading and unloading track. If the factory track should be on a curve, the scale track must be so built as to provide a straight track on the scales and for 40 ft. on each side, and if the same track must be used as a thoroughfare track then dead rails must be provided. These two latter provisions are required by the Minnesota Railroad and Warehouse Commission.

The cost of transportation of raw materials to the factory and the cost of distribution are largely affected by trackage facilities, and closer attention to this phase of the problem may save years of grief. A first-class factory poorly located with reference to trackage, resulting in awkward switching facilities, is only half a factory.

Continuous-Rail Crossing for Track Intersections

The severe wear and high maintenance cost of track intersections, especially under modern heavy railway equipment, makes it very desirable to substitute a continuous-rail crossing frog for the ordinary frog, providing a satisfactory device is available. The devices so far designed are of two types, having sliding and revolving blocks at the rail intersections. A continuous-rail crossing which is now being tried in service is of the sliding type, each corner of the crossing having a movable block whose lateral motion (diagonal to the track centers) gives a continuous rail for one or other track. The construction and the operating mechanism are very simple.

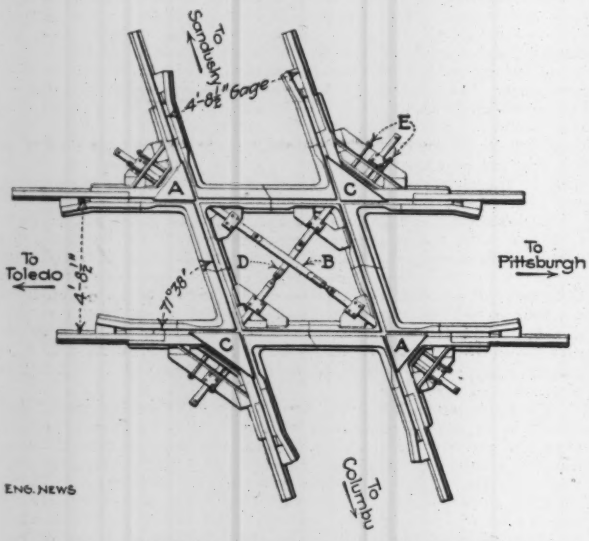


FIG. 1. PLAN OF CONTINUOUS-RAIL CROSSING
J. H. EYMON, MARION, OHIO, INVENTOR

In the plan, Fig. 1, the two sliding blocks (*A*) are moved by the operating rod (*B*), while the two blocks (*C*) are moved by the rod (*D*). The rods are connected for simultaneous movement, and if the crossing is equipped with signal interlocking plant, they are connected up with the interlocking mechanism. The two smaller rods (*E*) at each block are the bolt blo[cks] locking the blocks in whichever position they a[re]. Each of the operating rods is cranked horizontally a[t] end, and this part of the rod passes through a [slot] cam in the base of the crossing block. Thus a lon[gitu]nal movement of the rod shifts the blocks in a di[rec]laterally to that of the rod and diagonally to th[e] ter lines of the tracks. Turnbuckles on the rods [per]mit of adjustment of the throw.

The operation will be understood clearly from F[ig.] Here the crossing is set to give continuous rails for [the] track running from left to right. When the other t[rack] is to be cleared, the throw of the lever gives a stro[ke] to the flat operating rods and the blocks move in a diag[onal] direction upward (from the bottom of the view) and outward. This movement clears the flangeways of this second track and closes those of the right and left track. The two round rods behind each sliding block are those of the locking mechanism, and they partly conceal the ends of the operating rods.

The crossing shown in Figs. 1 and 2 is at the intersection of the main track and Sandusky branch of the Toledo Division of the Pennsylvania Lines, at Carrothers, Ohio. It is built to conform to the 85-lb. rails of the Am. Soc. C. E. section, and has a flangeway or throat width of 1¾ in. The entire crossing is of manganese steel, and is built in four sections, as shown. There are 28 trains daily on the Toledo branch and 32 trains on the Sandusky branch, and it is safe to assume that the crossing is thrown once for each of these trains. Besides this, Carrothers is a setting-off point, so that nearly every train switching there passes over the crossing at least twice in addition to its regular movement.

This crossing was built by the Indianapolis Switch & Frog Co. (Columbus, Ohio) for the Eymon Continuous Crossing Co., of Marion, Ohio. The inventor is J. H. Eymon, of Marion.

FIG. 2. CONTINUOUS-RAIL CROSSING ON THE PENNSYLVANIA LINES AT CARROTHERS, OHIO
(The crossing is set for the track from left to right.)

Cast-Iron Pipe with screw thread joints has recently been put on the market by Jos. B. Clow & Sons of Chicago. The screw threads are cut on the lengths of pipe by dies similar to those used for threading wrought-iron pipe. Cast-iron couplings are used and the entire pipe line is thus kept homogeneous. This pipe is claimed advantageous, therefore, for locations where ordinary wrought iron or steel pipe suffers seriously from corrosion. It is stated that the cast-iron pipe is already being used for wells driven in corrosive soil and by steam heating companies.

Cantilever Span of the Bloomfield Viaduct, Pittsburgh

The Bloomfield Viaduct, Pittsburgh, will create an important line of communication across Junction Hollow, a ravine through which the Pennsylvania R.R. and the Pittsburgh Junction R.R. (B. & O.) enter from the bank of the Allegheny River at 33rd St. The viaduct is located on the line of Ridgway St., and will connect Grant Boulevard on the south, or city side, with Liberty Ave. at Main St. on the north of Bloomfield side.

The Dravo Contracting Co. built the piers, for about $85,000, and the Fort Pitt Bridge Works is fabricating and erecting the superstructure, for a price of about $255,000. The cost of land, $75,000, and paving, $45,000, will bring the total cost to near the appropriation of $500,000.

The viaduct is a deck-cantilever structure with 400-ft. main span. It crosses about 185 ft. above the lower railway tracks (P. J. R.R.), and descends on a steady grade of 3.9% from south to north. The total width is 50 ft., with 34-ft. roadway. A uniform paneling of 20 ft. is used throughout the length of the steelwork, including the 20-ft. tower spans. The total length of superstructure is 1740 ft. 10 in., but retained embankments at the ends bring the total length up to 2099 ft.

The long north approach contains eight 60-ft. plate-girder spans and two 120-ft. truss spans; then follows the cantilever structure with 120-ft. anchor arms, 20-ft. towers, 140-ft. cantilever arms, and 120-ft. suspended span; the south approach has one 120-ft. truss span and two 60-ft. girder spans. The steel erection is being handled by a gantry cantilever traveler on each end. Derricks set on the approach spans raise the material from street level to the deck and feed it forward to the travelers.

The general and detail design of the bridge was made in the city's Bureau of Construction, under N. S. Sprague, in direct charge of T. J. Wilkerson, Engineer of Bridges.

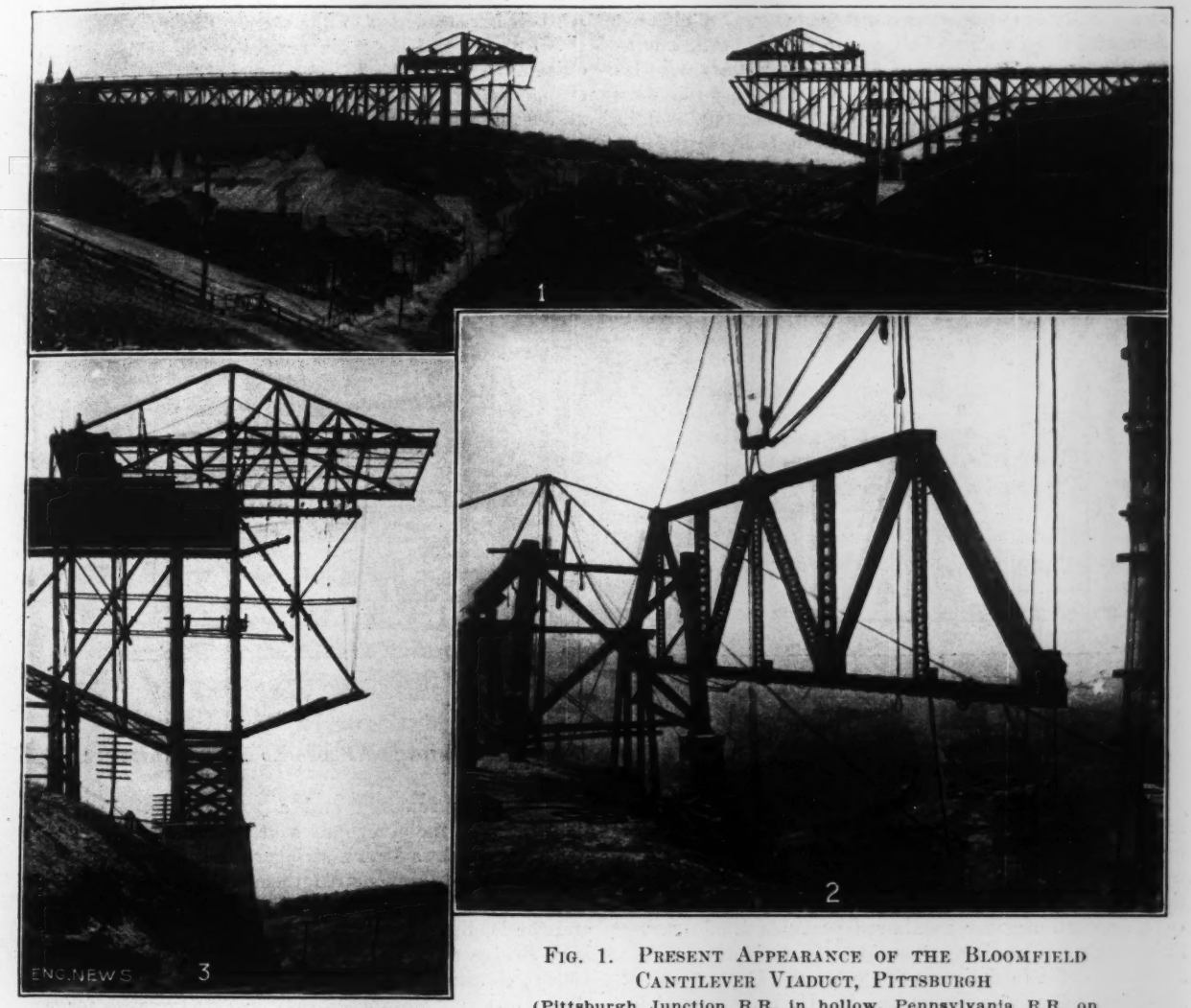


FIG. 1. PRESENT APPEARANCE OF THE BLOOMFIELD CANTILEVER VIADUCT, PITTSBURGH

(Pittsburgh Junction R.R. in hollow, Pennsylvania R.R. on southerly bank; view taken July 21.)

FIG. 2. HOISTING TO PLACE AN ENTIRE TRUSS AFTER ASSEMBLY ON GROUND

(120-ft. span adjoining north anchor arm; view taken June 6.)

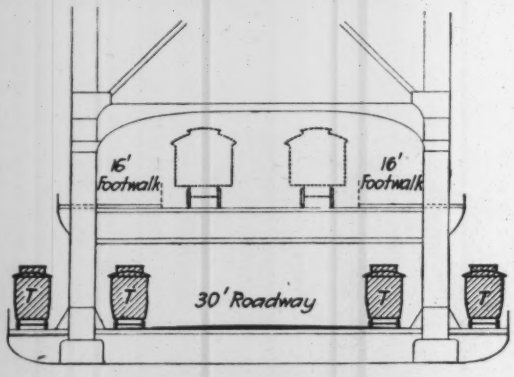
FIG. 3. TRAVELER STARTING ERECTION OF SOUTH CANTILEVER ARM

(Pennsylvania R.R. tracks at foot of pier. View in opposite direction from Fig. 1. Date June 30, 1914.)

Reconstruction of the Queensboro Bridge

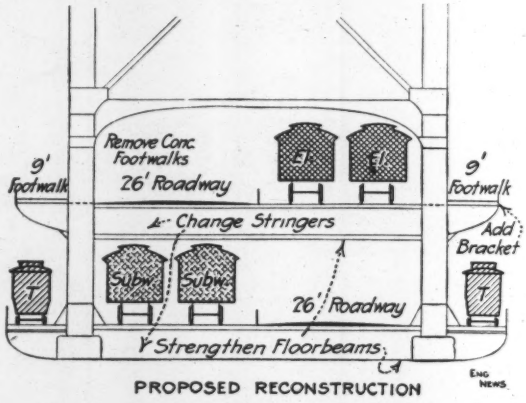
The Queensboro or Blackwells Island Bridge over the East River, connecting East 60th St., Manhattan, with Queens Borough, New York City, is to have its floor system and deck arrangement partly reconstructed. Plans were recently submitted by the city's Department of Bridges to the Board of Estimate. The reconstruction is for the purpose of accommodating the new rapid-transit lines which are to cross the bridge.

The bridge is a cantilever structure having two channel spans of 1280 ft. and 984 ft., respectively, with an intermediate or anchor span of 630 ft. over Blackwells Island. It was completed in 1908, but its two decks were left in a condition different from that contemplated in the design. The arrangement as built is shown by the diagrammatic cross-section, Fig. 1. In the original design, the upper deck was to carry four rapid-transit railway tracks between trusses and footwalks bracketed outside; the lower deck was to carry four trolley tracks and a central roadway as shown in Fig. 1.



PRESENT CONSTRUCTION

FIG. 1



PROPOSED RECONSTRUCTION

FIG. 2

CROSS-SECTIONS OF QUEENSBORO (BLACKWELLS ISLAND) BRIDGE, SHOWING PROPOSED REARRANGEMENT

Shortly before the bridge was completed, grave doubts arose over its strength, largely in consequence of the collapse of the Quebec bridge some months before. The weight of the Blackwells Island Bridge greatly over-ran the dead-load assumed in the design, and the members were proportioned for maximum probable traffic rather than maximum possible congestion. Investigations of the strength of the bridge were made for the Department of Bridges by Boller & Hodge and W. H. Burr separately, and the results (reported in ENGINEERING NEWS, Nov. 12, 1908, pp. 516-524) indicated that four rapid-transit lines would overstress the truss members seriously. Partly as a result of these doubts and investigations, the upper deck brackets were omitted, and sidewalks were constructed on the outer set of upper-deck stringers, as shown in Fig. 1 (the construction of these sidewalks was described in ENGINEERING NEWS, Jan. 28, 1909, pp. 94-98).

As the plans of the Public Service Commission call for four rapid-transit tracks across the bridge, it is now necessary to make some rearrangement. However, the adoption of the original deck plan, or of any plan giving only 30 ft. roadway, is strongly opposed by inhabitants of the Borough of Queens who claim that vehicle traffic absolutely demands a full deck width of 52 ft. Further, it is inconvenient to carry to the upper deck the subway trains approaching the bridge from the west in tunnel.

The plan now proposed meets these demands by using half of the lower deck and half of the upper deck for roadway (thus giving two 26-ft. roadways), placing two subway tracks on the other half of the lower deck and two elevated-railway tracks on the upper deck and taking care of the trolley tracks and the footwalks on brackets. All this is represented by the sketch, Fig. 2.

No member of the main trusses of the bridge will require to be altered for this reconstruction. The following changes will have to be made, however: The footwalks removed; brackets attached outside the upper deck and new (narrow) footwalks built, with a board floor instead of a heavy concrete floor; two sets of the upper-deck stringers removed and roadway stringers substituted; the other pair of upper-deck stringers shifted slightly to suit 10-ft. rapid-transit cars; some upper-deck floor-beams strengthened; the lower-deck roadway and the two inner trolley tracks removed and a roadway built on half the width; on the other half width, roadway stringers removed and subway-track stringers substituted; and the lower-deck floor-beams strengthened.

The loadings now used by the Department of Bridges and the loadings used in the design of the Blackwells Island Bridge are: Trolley, 1460 lb. per lin.ft. (formerly 1000); elevated railway, 1810 (formerly 1700); subway, 2000 (formerly elevated-railway loading). Also, for the present purpose a live-load of 10 lb. per sq.ft. of sidewalk is considered justified, because with such a loading and a speed of movement of 3 mi. per hr. about 10,000 persons can cross the bridge in either direction per hour, which is regarded as far beyond any possible traffic over the bridge. The chances of crowding on the sidewalks on special occasions is considered of no importance because it may be prevented by the Police Department, because it is not likely to cover the full width of the sidewalk, and because the sidewalk loading is not critical in the design or safety of the bridge anyway.

With regard to possible concentration of train-loading, the Bridge Department counts on spacing trains

apart as described below by automatic block-signals in such a way that four lines of track will not produce greater stresses (and generally lower stresses) than ordinary double-track arrangement. Using the most unfavorable position of loading which the block-signals will permit, the calculations of the Bridge Department show maximum stresses as follows:

Tension in the top chord, about 500 lb. in excess of the originally specified working-stress of 30,000 lb. per sq.in. for nickel-steel; compression, no stress attaining the value allowed by the formula $20{,}000 - 50\frac{l}{r}$, which is the specification formula modified by the recommendations of Boller & Hodge and W. H. Burr. The department regards the bridge as absolutely safe under the traffic loads which it will carry when rearranged as per Fig. 2. Austin Lord Bowman, Chief Engineer, reported as follows to F. J. H. Kracke, Commissiner of Bridges: "No strengthening of any member of the main trusses is necessary to allow traffic to be carried across the bridge under this plan."

Signaling the Bridge

The arrangement of block-signals on the four rapid-transit tracks will be unique: On each of the four rapid-transit tracks, block-signals will be set at intervals of about 100 ft. and each will be equipped with an automatic stop, so that trains are spaced positively. On each deck the trains will run right-handed in both directions, so that there is one eastbound track and one westbound track on each side. Calling the two eastbound tracks "parallel tracks" and an eastbound and westbound pair "opposing tracks," the following functions will be performed by the signals: Following trains on the *same track* will be spaced 3400 ft. apart.* Trains on *parallel tracks* will be spaced 600 ft. apart. Trains on *opposing tracks* will be without influence on each other except at a block section 600 ft. long in the middle of each channel span, but here the arrangement will be such that one pair of parallel trains (600 ft. apart) must pass through and out of the block before the opposing pair can enter the block.

The effect of this latter arrangement will be that the middle of each channel span, which is the portion having the greatest influence on stresses in the bridge, cannot be occupied by more than one pair of trains, and this pair at 600-ft. spacing, which is sufficient to reduce the effect to that of a single train at midspan.

The theoretical capacity of this signaling system with a speed of 29 mi. per hr. will be 45 trains per hr. per track. Allowing for a certain amount of delay for each train, a real capacity of 41 trains per hr. per track is counted on.

*At a speed of 29 mi. per hr., this distance of 3400 ft. corresponds to 88 sec. The operation in the present Interborough subway does not secure closer spacing of trains in regular service than 90 to 110 sec.

Terminals and Connections

The trolley tracks on the brackets of the lower deck will swing outward at the west approach and descend into tunnels passing west along 59th and 60th St., respectively, south and north of the two subway tunnels leading from the lower-deck rapid-transit tracks of the bridge. At Third Ave. (about 1200 ft. west of the end of the bridge approach), the trolley tunnels will have descended sufficiently to pass under the subway tunnel and will connect with each other in a transverse loop station under the roadway of Third Ave.

At the east end of the bridge the trolleys will connect directly with the Queens trolley network.

A terminal structure at the east end of the bridge will provide for the elevated- and subway-train traffic interchange. In approaching this terminal the various tracks will change their levels so as to bring the eastbound tracks to one level and the westbound tracks to another level. The lines continue thence easterly into Queens Borough.

At the west end of the bridge the Second Ave. elevated tracks connect directly with the upper deck of the bridge by a viaduct structure.

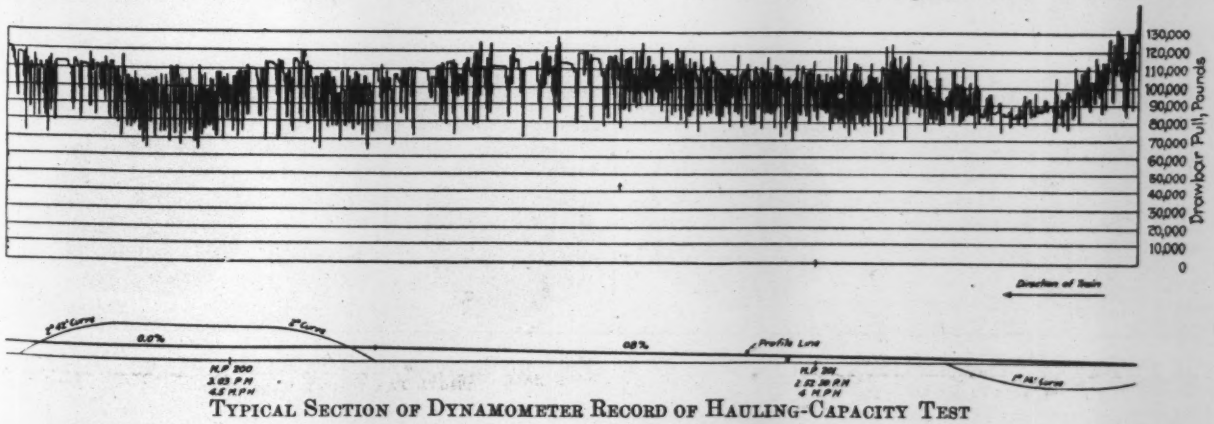
The greatest approach gradients are: Rapid-transit tracks, 5.2%; roadways, 5.8% at Manhattain end and 5.4% at Queens end. Most of the vehicle traffic at present consists of power vehicles, so that steep grades are not seriously objectionable.

The total cost of putting the bridge into shape for operation, according to Fig. 2, is estimated at $3,024,000.

F. J. H. Kracke is Commissioner of Bridges, A. L. Bowman is Chief Engineer, C. M. Ingersoll is Traffic Engineer, and E. A. Byrne is Deputy Chief Engineer.

World's Largest Locomotive Tested for Tractive Effort

The big articulated locomotive of the Erie R.R., described in Engineering News of May 7, p. 1046, was subjected to a hauling-capacity test on the Susquehanna division on July 23. The test was made from Binghamton, N. Y., to Susquehanna, Penn., a distance of about 23 mi. The locomotive was at the head of a train of 250 fifty-ton steel gondolas loaded to full capacity, and a dynamometer car. The train weighed 17,912 tons, exclusive of the locomotive, which weighed about 422 tons, and the



Typical Section of Dynamometer Record of Hauling-Capacity Test

length of the train was 8547 ft. The grade was practically level, the maximum being 0.09%, with 5° curvature.

Pushers were in readiness to assist in getting the train under way and were used in making the start from Binghamton; but at Great Bend, where the locomotive took on water, pushers were not used in starting. They pushed the slack forward until the lead locomotive had all the cars moving, after which they were uncoupled and followed the train for emergencies. Communication was maintained between the head and rear of the train by portable telephones, which made it possible for the pushers to work efficiently with the lead engine at starting. The maximum drawbar pull is shown in the accompanying section of the dynamometer record. The following tabulation gives the main facts:

Number of cars in train	251
Total weight of train excluding locomotive	17,912 tons
Total length of train	1.6 mi.
Maximum speed obtained	14 mi. per hr.
Maximum drawbar pull	130,000 lb.
Minimum drawbar pull	67,000 lb.

These data were furnished by R. S. Mounce, Engineering Department, Erie R.R., New York City.

Analyses of Tubercles from the Interior of a Cast-Iron Water Main

The illustrations intended to accompany the analyses of samples of tubercles from the cast-iron pipe at the High Hill Reservoir gate house of the New Bedford, Mass., water-works, described in ENGINEERING NEWS of last week, p. 328, are shown herewith. Each ring shown in illustrations of the bottoms of the tubercles, Fig. 2, represents about a year's growth.

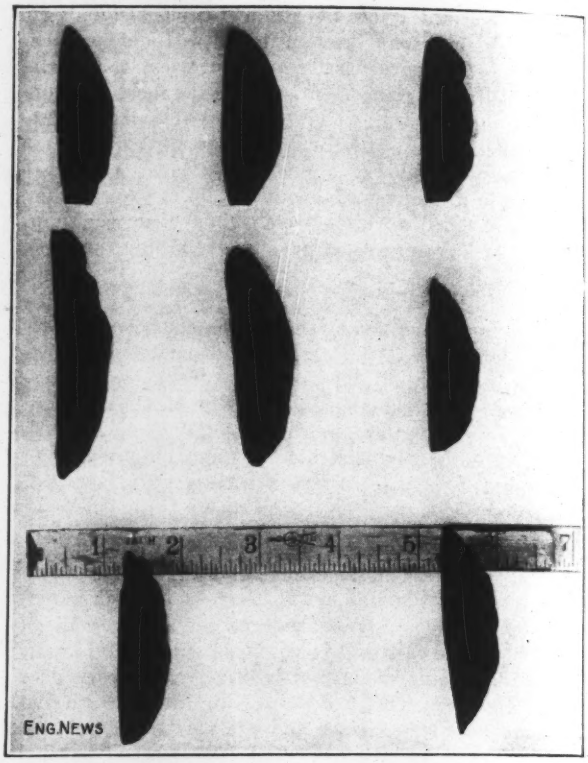


FIG. 3. SIDE VIEW OF TUBERCLES

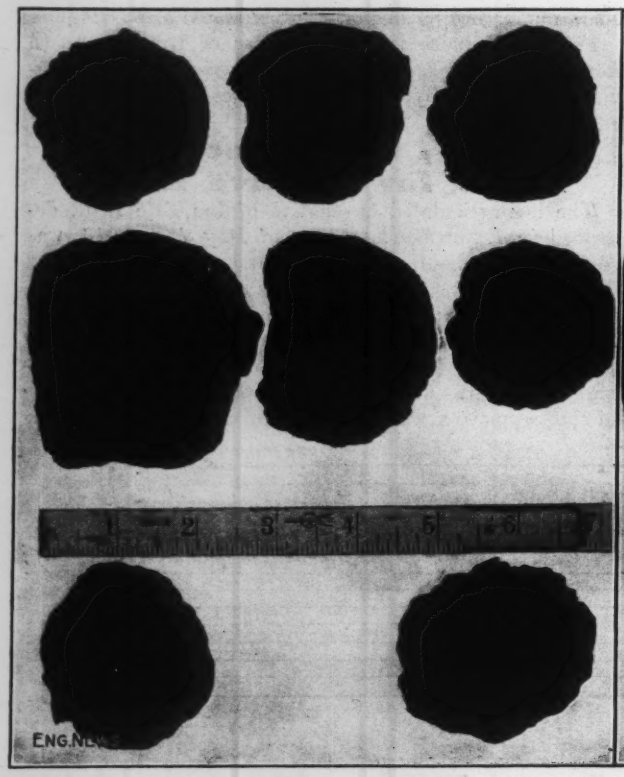


FIG. 1. TOPS OF TUBERCLES FROM THE INTERIOR OF A CAST-IRON WATER MAIN

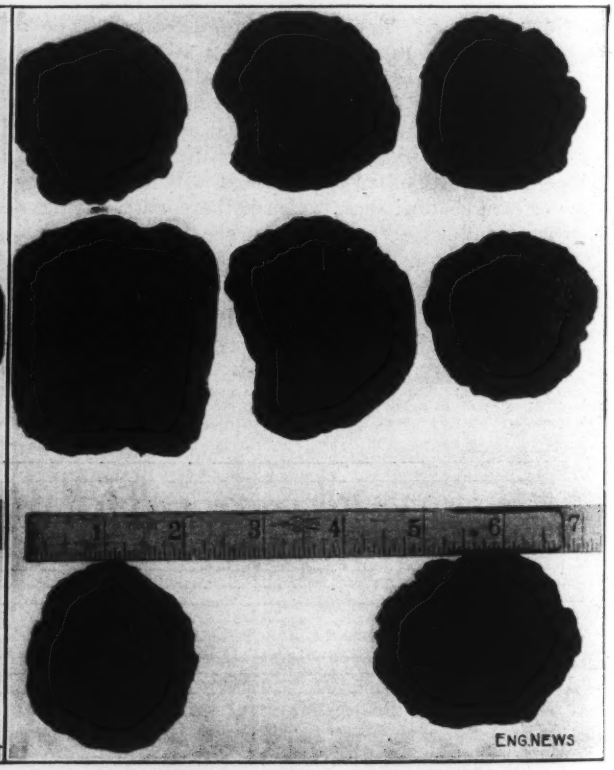


FIG. 2. BOTTOMS OF TUBERCLES, SHOWING RINGS OF ANNULAR GROWTH

Editorials

The Effect of Increases and Decreases in Street-Railway Fares

At the last mid-year conference of the American Electric Railway and allied associations early this year, figures were presented to show that one- and two-cent reductions of street-railway fares did not result in the notable increase of traffic which some advocates of lower fares claimed would come. From the studies of the riding habit in several American cities, where reductions were to be observed, it appeared that the general business experience in stimulation of trade (directly proportional to unit-price reduction) was not followed, and the tenable statement was made that this law had a limitation when very small unit prices were concerned—as these required a much larger percentage reduction to have appreciable effect. Admitting for the moment that these figures truly reflected the habits of American riders, the converse cannot be said to be true—that increases in fare do not work a material reduction in travel. A striking illustration of this point is seen elsewhere in the discussion of the experience of the Hudson & Manhattan railroad, which operates rapid-transit tunnel lines between New York City and New Jersey. This company raised the fare from five to seven cents on one line. There was ample excuse for doing this in the continuing deficits which the company bore as the result of operations. However, the results show that it undoubtedly was an unwise move. In the first year under the increased fare there was a drop of 17.6% and in the second year a further drop of 5.8%. In the two years which have elapsed, the gross income has been increased by this raise a total of some $970,000 over what they were, but against this increase has to be set off the very probable loss of $1,300,000 gross gain which the company would have made had the traffic continued to grow at about half the rate it was growing when the new fare was put into effect. Incidentally, the traffic on this line has to compete with good ferry and surface-car service and possibly will remain some 40% below what it might be under a five-cent fare. The company has a heavy investment in tunnel construction and needs to cultivate in every way the growth of traffic.

Causes of Railway Derailments

Accident Bulletin No. 50 just issued by the Interstate Commerce Commission gives statistics of accidents occurring on United States railways during the last quarter of 1913, and shows some interesting facts regarding the causes of derailments. The total number of derailments on steam railways during the three months was 2307, but only 576 of these were due to defective roadway, while 1091 were due to defective equipment. Broken rails were responsible for 128 derailments, while 245 derailments were due to broken wheels; 102 to breaks or defects in axles or journals; 162 to breaks or defects in brake rigging, and 116 to breaks or defects in draft gear. Broken arch bars caused 73 derailments and rigid trucks 65. It is worth noting also that this quarter included the month of December, one of the winter months, when most rail breakages occur.

We have no wish to minimize the importance of measures to secure sound railway rails, free from the danger of breakage, but it is at least worth careful consideration that only one-fifth of the derailments due to defective track were caused by broken rails and that there were nearly twice as many derailments due to defects of rolling stock as to all the defects in the track. Considering the character of the labor necessarily employed in track work and the large territory that has to be covered, with the general tendency of railway financial authorities to economize as much as possible in expenditure on track repairs, the above showing is most creditable to the engineers and the men under their direction who are responsible for railway-track maintenance in the United States.

The statistics of derailments from rail breakage in the above report prove, what every railway engineer pretty well knows, that the great bulk of the steel rails in service on American railways are sound and tough and equal to the tasks imposed upon them. If this were not the case, rail breakages under the extraordinarily heavy wheel loads and high speeds common in American railway practice would be many times as numerous as they are.

This same Accident Bulletin also shows, however, that there are a few very bad rails in service. Two examples of rails of this sort are given in this report. One is a rail which broke under a freight train on the Southern Ry. in North Carolina Mar. 31, 1913, and was found after the accident to be separated into nine pieces, the shortest about 7 in. long. This was an 80-lb. rail rolled in November, 1904, and the cause of the breakage was traced to transverse fissures in the rail head.

A much more remarkable case of rail breakage, however, occurred on a coal-trestle siding in Washington, D. C., on Oct. 31 last. A Pennsylvania R.R. switching locomotive pushed some loaded coal cars on the siding and started to haul away four empty cars. It had moved barely two feet when one of the rails under it broke and the locomotive tipped over and fell to the ground 14 ft. below. The siding was laid with 85-lb. rails laid on ties two feet apart on centers. The ties appear to have been badly decayed, but this was no excuse for the rail breaking instead of bending under the static weight of the locomotive. Manifestly, such brittle rails anywhere in railway track are a dangerous menace. The chief object of those who draft specifications for steel rails and those who carry them into execution should be to prevent any such brittle and dangerous material being placed in the track.

Steam Distribution from Central Stations

The report published in our issue of July 30, on the condition of the mains of the New York Steam Co., is the first valuable technical information that has appeared for a long time concerning the distribution of steam through city streets.

In many cities of the country there are steam mains through which steam is distributed from central stations at low pressure, for heating purposes only. Usually the business is carried on by electric lighting companies, who thereby utilize the exhaust steam from their engines much more profitably than they could do by discharging it through a condenser. In New York City, however, the New York Steam Co. distributes steam at nearly 100 lb. pressure under a considerable mileage of streets in the crowded downtown business district.

At the time this plant was originally built, the distribution of power from a central station was comparatively a new development in engineering, and several systems were in competition. In some of the English cities, extensive systems of mains were laid down for the distribution of power by water under high pressure. In the United States at that time also many water companies looked with favor on the use of water taken from the city mains under pressure for operating hydraulic elevators, small motors, etc. In France the Popp system of compressed-air distribution attracted world-wide attention and was copied on a smaller scale in several other cities. Besides these systems there was the mechanical distribution of power by belts and ropes, of which the cable railway so extensively developed in the '80's was the most remarkable development.

The system of the New York Steam Co., when originally put down, was designed to compete with these other systems of power distribution. Its promoters claimed that the ready use of the high-pressure steam in existing steam-engine plants, with its availability for heating as well as power, made the steam distribution the most advantageous system; and their dream was that similar plants would be constructed in many other cities.

In the early years of operation of the New York system, very serious troubles were experienced with the street mains. The heat losses from the system were very heavy, the great amount of condensation and resulting troubles with expansion and contraction compelled the frequent digging up of the streets; and the general impression among engineers was that steam mains underneath city streets were an unmitigated nuisance.

For the past fifteen or twenty years, however, little has been heard concerning the New York Steam Co.'s operations. It has continued to carry on its business but without very greatly extending its field; and the improvements it made to its system of mains, following the troubles of twenty years ago, have seemed to obviate much of the difficulties then complained of. The report, which we printed two weeks ago, however, makes it evident that its steam mains are only less objectionable now than they were in the early days and that the difficulties experienced with them are such that were the mains not already in the streets, certainly no city government run on business principles would grant a franchise for putting them there.

It must be remembered that the earth underneath New York City's streets is already filled so full of underground pipes that it is difficult to find room for many more, especially in the narrow downtown streets where the high-pressure mains of the steam company are chiefly laid. To a certain extent, however, the above statement applies to steam mains anywhere and especially to those using high pressure. It is true that by using a much higher class of work in the laying of steam mains with ample provision for heat insulation and free expansion, it is possible to put in a system that will be much less troublesome; but such improved mains add materially to the cost of the system and experience indicates that the cost of distributing steam through city streets, at least under the conditions prevailing in New York, is so heavy that there is little profit in the business.

Of course, under present-day conditions electric power distribution has put all other systems out of the running and no engineer at the present day would seriously consider building a plant to distribute steam for power generation. Even in the distribution of steam for heating purposes, the indications are that the limitations of distance are important, and that the most successful plants are those operating in comparatively limited territory.

Finding Money to Pay for Street Paving

A good many cities are wrestling with the problem of radical improvements in their street pavements. The general use of automobiles has developed a public opinion far more sensitive to the disadvantages of poor street pavements than existed a dozen or twenty years ago. The rough stone block paving which was accepted without question in former years is now severely criticized. The public demand is for wood block, asphalt, brick, close-jointed stone block, or some other type of pavement with a smooth surface. But to substitute such pavements for the old and badly worn pavements of which every city possesses a large mileage, and to pave the miles of streets not paved at all, means the expenditure of a very large amount of money. The abutting property owners object to bearing the burden of this work and rightly so, since the large amount of traffic which an improved pavement draws to a street is an injury rather than a benefit to residence property. On the other hand, to raise money by a general tax levy for wholesale repaving would raise the current tax rates to a point which the public would not stand for. Hence a bond issue seems, in most places the only method available of raising money. On the other hand, most cities are already carrying a burden of debt which is partly made up of bonds issued to pay for pavements which have already been worn out; hence this dangerous plan of financing is properly condemned by engineers and others.

In Cleveland, Ohio, the question of what to do about the city's pavements has recently been thoroughly investigated by a citizens committee of 15, organized by a general committee made up of representatives of civic organizations. The president of the committee of 15 was Dr. Chas. S. Howe, the president of the Case School of Applied Science. Among other members of the committee were Messrs. Chas. A. Otis, James R. Garfield and Frank C. Osborn. The committee's report, which was presented on July 20, shows that of the 826 miles of

streets in Cleveland about 500 miles are paved. Fully one-half the paved streets need some repairs and at least 50 miles need repaving at once. The city has not been spending enough money on pavement maintenance to keep the streets in order and the pavements are growing worse every year. In addition to this, the Cleveland Street Railways Co. has neglected its obligation to keep well paved the space between its tracks and one foot on each side. These repairs were postponed while the company was engaged in its long fight over its franchise rights; and since then, the company has expended as little as possible on paving work.

The taxpayers of the city pay 85% of the road tax raised in Cuyahoga County and they pay also $407,000 each year in state road taxes. Thus the tax payers of the city pay annually over $800,000 for the building of roads outside of Cleveland.

The committee proposes to deal with this situation as follows: It recommended that the city should provide about $150,000 a year for new paving; and where streets are repaved, one-half should be paid by the property owners and one-half by the city, the total amount to be raised by the city for this purpose being about $670,000 per annum. This money should be raised by general taxation and not by an issue of bonds. The committee further recommended that efforts should be made to have the laws amended so that a part of the taxes paid by city property owners for state and county road purposes should be expended on streets within the city.

It was further recommended that a part of the funds required for repair and maintenance of city streets should be raised by the assessment of a wheel tax on all vehicles.

Still another important recommendation of the committee was that the entire work of paving, repaving and paving maintenance should be under direction of a Commissioner of Streets. Such an officer is provided for in Cleveland's new charter, but has never been appointed. The committee recommended that the Commissioner of Streets should be a thoroughly trained civil engineer who has specialized in road and pavement work and should receive a salary of at least $4500 per annum.

This is the first case on record, as far as we recall, where an organized protest has been made against the taxation of cities for the construction and maintenance of country roads. For some years past, through the development of state and county road work, the tendency has been to place upon the large taxpayers of the cities a large part of the burden of building and maintaining better country roads. That protest against this burden would be heard sooner or later was to be expected.

Through Routes Versus Terminals

The City Club, of Chicago, has just published a notable monograph, entitled "Through Routes for Chicago's Steam Railroads," which is well worth the study and careful thought of any engineer interested in the problem of city transportation. The author of the pamphlet is Mr. Geo. Ellsworth Hooker, Secretary of the City Club of Chicago. Mr. Hooker was also secretary of the Special Street Railway Committee of the Chicago City Council in 1897-8. Mr. Hooker's monograph is a quarto of some 90 pages, profusely illustrated with maps and diagrams, and to the engineer interested in city transportation is of much broader interest than the discussion of the local problems at Chicago.

The scheme which Mr. Hooker sets forth has the backing of so eminent an engineer as Mr. Bion J. Arnold. In March last, Mr. Arnold presented before the City Council Committee on Railway Terminals a preliminary study to show the possibility of applying the through-routing principle to the Chicago steam railways engaged in local passenger service.

The local passenger traffic in Chicago is now moved by surface street railways carrying 600,000,000 passengers per annum at an average speed of 9 miles per hour, elevated railways carrying 164,000,000 passengers at an average speed of 14 miles per hour, and suburban steam railway lines carrying 42,000,000 passengers at an average speed of 24 miles per hour. Mr. Hooker argues that a much larger proportion of the local railway traffic should be carried by the steam railway lines, which, by the way, he assumes are shortly to be altered to electric traction.

It is, however, impossible in Chicago's densely crowded central district to find the room for the large amount of rolling stock which would be required if the suburban steam railways run into the present crowded terminals in and close to the business district. Mr. Hooker urges, therefore, that there should be through routing of this local passenger traffic. For example, a steam railway train leaving the northern suburb of Evanston should not be stopped and turned to retrace its journey when it reaches the station in the central district, but should continue on southward to Hyde Park or some other farther point in the southern suburban zone, where it can be stopped and turned to retrace its through journey. Mr. Hooker discusses the principle of through routes in connection with other cities as well as Chicago, such as New York, Boston, Paris, London and Berlin, and considers its application also to street railway traffic. It is this latter feature we believe which most deserves the attention of engineers.

The electric street railway system in most American cities, unfortunately, has been developed without very much system or plan. The question on what streets it should be located has depended much more upon the prejudices and inclinations of the property holders in that street than upon the need of good service for the whole city. There has, however, grown up in most cities a system under which all or nearly all the street railway lines radiate from the various suburbs to some point in the business center, and in numerous cities the congestion in the business center as a result now presents a serious problem.

Boston, with its narrow and crooked streets, was the first American city to feel that problem in an acute form and the construction of the first Boston subway was the result. New York City has had for more than a score of years an aggravated case of crowded terminals in the center of the city at the Manhattan end of the old Brooklyn Bridge. A similar congestion once existed at the Brooklyn end of the same structure and millions of city money was used to obtain additional room for the Brooklyn terminal of this bridge. When through routing of cars across the bridge was established, the Brooklyn terminal crush disappeared as if by magic.

As we have remarked above, there are numerous cities

in which this problem of the congestion of street cars in the center of the city has become a very serious matter. We have in mind one city of a half a million population where the crowding of passengers on the cars all day long and not in the rush hours merely is nothing short of scandalous. Such conditions would not be permitted for a single day on a street railway in any city of Germany or England. The management of the company, which has long been notorious for its inefficiency and absolute disregard of public necessity and convenience, has long made the stock excuse that the crowded condition at the business center prevented the running of any more cars. It has at last awakened to the fact that the congestion on its lines is seriously limiting its traffic growth and so delaying the movements of its cars as to materially cut down its earnings, and it is therefore proceeding to invest a very large sum of money in the construction of a great terminal passenger station and car depot near the [illegible] of the city. The value of a reservoir of cars at this [illegible] is debatable, but it seems likely that the cong[illegible] above referred to might have been remedied at a [illegible] part of the cost by intelligent through routing of ca[illegible]

It will not escape notice that this principle is of [illegible] broader application. One reason for the vast reduction of transportation costs that has taken place in the last fifty years has been the steady development of through routes for both passengers and freight. The consolidation of railways into great systems thousands of miles in extent has put an end to the changing of cars and the shifting of loads every hundred miles, or less, which was common in the days when a multitude of little railway companies owned short lines in New England and the Middle States. In fact, in all manufacturing and transporting fields the effort is to make the process continuous.

Letters to the Editor

Window Protection More Important than Structure in Fireproof Buildings

Sir—Your article, "A Real Fireproof Building," in the July 16 number does not sufficiently emphasize the fact that what saved the reinforced-concrete storehouse was its small windows with their double-protection wire-glass in metal frames plus inside automatic shutters. The reinforced concrete had nothing to do with its salvation. The concrete walls are cracked in many places and the reinforcement is exposed in a few places but some of the cracks were apparently present before the fire.

Given this double window protection, a brick building, even with wood-joisted construction, would have resisted the fire just as well—a fact proved by the unscathed condition of the boxes just below the windows inside, and the sprinkler heads 3 ft. away from the windows which did not go off. It should be noted also that the very small windows and the inside shutters hinged at the top to swing down would be impracticable for buildings like factories, office buildings and stores.

The power house of the Salem Electric Light Co., near the Naumkeag Mills, a brick building with large windows of wire-glass in metal frames was a much better example of the kind of windows required in ordinary mercantile buildings. It came through the fire with only a small amount of blistered paint on the inside. The old gasometer used as a storehouse by the Naumkeag Co. was a brick building with double metal doors, no windows, and a patent roofing on wooden boards. The fire did not penetrate it.

The buildings which were saved simply emphasize again the necessity for the precautions to be taken against outside exposure, viz.; brick or concrete outside walls, incombustible roofs and thoroughly protected openings.

CHARLES W. KILLAM,
Ass't. Prof. of Architectural Construction.
Harvard University, Aug. 3, 1914.

"A Dry Land Mattress on the Mississippi;" the Sequel

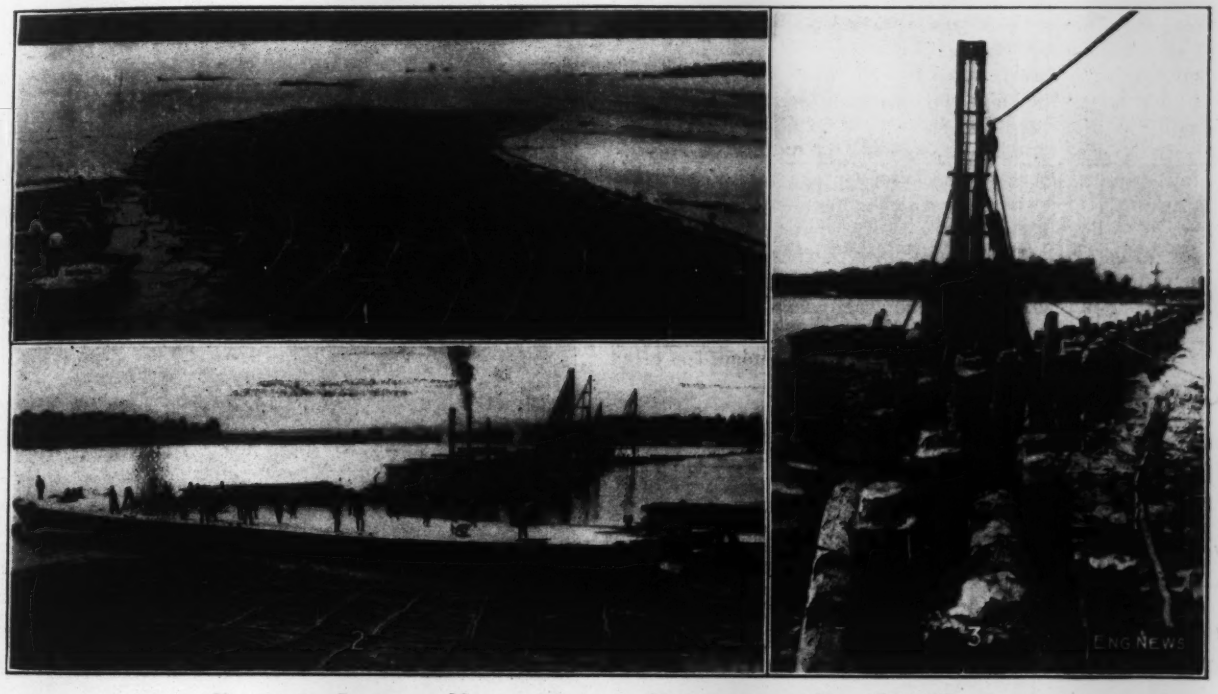
Sir—The quoted title heads a description, in ENGINEERING NEWS, June 4, 1914, p. 1243, of a mattress on the Mississippi, near Chester, Ill., constructed on the ground in order that the piledriving and mattress construction could be prosecuted simultaneously, when conditions were favorable.

The hoped for "rise," sufficient to float the plant over the bar, was forecasted by the Missouri River gage reports about the middle of June, and preparations were then made to begin the work at the earliest possible moment. Unfortunately the river did not reach a working stage until the latter part of the month, and valuable time was lost on account of Sundays and holidays; mattress construction and piledriving were begun on June 19, when soundings showed 2 ft. of water over the mattress end.

From the highest point of the mattress to end—400 ft.—the slope was 1¼%, consequently difficulty was experienced the first day in maneuvering the two pile-drivers placed on the work. Additional drivers were placed, as the river rose, until at the crest (June 22. "Belle of Memphis Towhead" = 20.5 ft. St. Louis gage), six were in commission. Knowing that the rise would be of short duration and probably barely sufficient to float the drivers over the high point of the mattress, mooring piles were driven upstream and the leading drivers dragged, to the extent of their engine capacity toward the bar top. Fig. 2 shows the far drivers hard aground, working in 1½ ft. of water.

Equal haste was necessary with the mattress construction on account of a second ridge or prong of the towhead that had to be crossed—background, Fig. 1. While it was not thought that the second ridge could be reached before the water began to fall; yet it would have been both economical and advantageous to build to the ridge, since scour usually takes place at the exposed end of a

hurdle mattress. In this endeavor aid was rendered, for a few days, by the river. The swift current in combination with the shoal water formed an undertow or suction under the plant, which caused a continuous scour of one to two feet in front of the unsunk mattress. However, as the water fell the scour decreased and failed to overcome the river fall and the rise of the bottom; the brush barge grounded, necessitating the launching and sinking of the mattress (Fig. 2). The direction of the weaving plant was reversed; the bows of the light-draft flats were shoved on the bar ridge and mattress building proceeded in the opposite direction until an overlap was made with the mattress previously sunk. By reversing the plant and direction of mattress construction, 300 ft. of mattress was added to the length. Fig. 2 shows the mattress thus constructed with preparations for weighting; the overlap and the hurdle end are in the foreground, the second ridge of the bar and river channel in the background.



FIGS. 1-3. LAYING A MATTRESS ON THE MISSISSIPPI IN VERY LOW WATER

Across the bar, piles were driven tip down. A greater cross-section of pile was thus obtained where the greatest breaking strength was needed.

At the top of the first ridge too shoal water for the piledrivers caused a small gap to be left in the hurdle, which was closed by cutting holes in the mattress and jetting in the piles. Fig. 3 shows a driver jetting piles 75 ft. distant.

During this "rise" 1000 ft. of hurdle and 1300 ft. of mattress was built. of which 300 ft. of mattress, in advance of the hurdle, is ready for piling on the next rise above the 20-ft. stage, St. Louis gage. That this "rise" will occur before the spring of 1915 is extremely doubtful.

F. Y. PARKER,
U. S. Assistant Engineer.

July 24, 1914, St. Louis, Mo.

On the Necessity of Heavier Pavement Foundations

Sir—I hope the article by Daniel B. Goodsell, on "Pavement Foundations for Heavy Traffic," in ENGINEERING NEWS of July 23, will call forth thorough discussion of the subject by municipal engineers in this country. It has long been my opinion that in laying pavement foundations, which to all intents and purposes should be useful for from 30 to 50 years, municipal engineers are extremely shortsighted in continuing to recommend 6 in. as the maximum thickness. This thickness is barely sufficient under favorable conditions for present traffic; and no account is taken of future growth in size of loads.

Everyone knows the pressure that is brought to bear on city officials to lower the first cost on all public improvements, and this must be credited as one of the extenuating circumstances which may have influenced the engineer against his better judgment. Four- and five-inch foundations, however, are altogether too common in the United States, and are entirely inadequate for even present needs.

All will agree that wheel loads have been increased enormously within the past five years with no apparent limit in sight for the future. A rich 6-in. portland cement concrete foundation may be strong enough to carry the heaviest load over ordinary sized depressions in the subgrade, without actually breaking down, but this is not all that is required of a pavement foundation.

The foundation must be rigid enough to maintain the wearing surface without appreciable deflection or vibration. For these purposes, mass as well as strength is essential just as in a reciprocating-engine foundation the mass necessary to absorb the vibrations determines the size, rather than the amount of load carried.

The increase in the speed of heavy loads due to motor trucks, has been as severe on old pavement foundations as the increase in the weight of the load itself. Everyone has undoubtedly felt the violent jarring and shaking of the entire surface of a pavement during the passage of a loaded motor truck going 10 or 12 mi. per hr., especially if the pavement was slightly uneven. Recent experiments by the U. S. Bureau of Standards have shown that the effect of a slowly moving load of three tons on a block pavement laid on a 6-in. foundation could be detected as much as 110 ft. away. Any wearing surface is more or less injured by these constant deflections and vibrations.

Kansas City, a year ago, increased the thickness of foundation on business streets and trafficways from 6 to 8 in. of 1:3:6 portland cement concrete, and on residence streets from 5 to 6 in. No foundation is laid less than 6 in. thick, and several streets have been repaved with a new foundation 8 in. thick. Eight inches on residence streets and 10 or 12 on business streets should be required and will probably be specified as soon as the public will allow it.

In Kansas City, the entire cost of all paving, repairing or repaving is assessed directly against the abutting property, the owners of which consequently think they ought to have a deciding voice in what they have to pay for. There are a great many streets with a 6-in. natural-cement-concrete foundation, which the Engineering Department is recommending be replaced in nearly all cases of repaving. Why a foundation, which has stayed right where it is for 15 yr. should have to be replaced is often a mystery to the taxpayer.

It is my observation that a weak or insufficient foundation (and this does not necessarily mean a sunken or fractured base) is more of a detriment to asphalt and creosoted wood-block than it is to cement-grouted brick or stone-block. The last two named pavements are in a way partially self-supporting and apparently distribute loads over greater areas of base and subgrade.

Engineers should give the question of pavement foundations more careful and serious consideration; in which case, they will undoubtedly specify leaner mixtures and much thicker bases, which is in conformity with foreign practice mentioned in Mr. Goodsell's article.

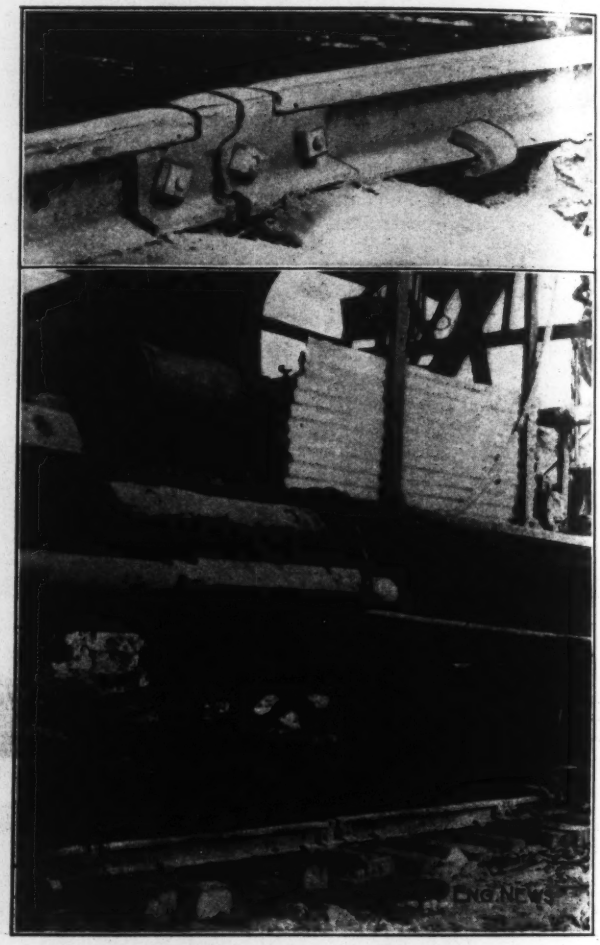
CLARK R. MANDIGO,
Assistant City Engineer.
Kansas City, Mo., July 27, 1914.

NOTES AND QUERIES

Preparation and Sale of Assessors' Maps—A correspondent in Suffolk County, N. Y., has sent us the following query, in answer to which we would be glad to hear from some of our readers:

I write to ask some information as to the preparation and possible sale of assessors' maps. In a practice of something like 30 years, which has consisted largely of land surveying, I have accumulated information practically sufficient for the preparation of assessors' maps, that is, maps showing each individual holding with the area of the larger plots an the length of frontage of the smaller plots. What I want to know is something about the experience of other men in similar work; have such maps been published and sold as a speculation or have they been published in conjunction with some established firm of map publishers, or have they been sold outright to the local authorities? If the sale last suggested has taken place, have the authorities solicited bids for the work, or have they made a private bargain? I would say right here that the local authorities have no engineering organization of any kind which could do such work as this. In the event of competitive bidding as suggested above, how is the specification prepared upon which the bids are based? I do not know of any country township which has gone into any such work as this comprehensively, and the experience of anyone whether successful or not, would be gladly welcomed.

We have been asked where the flexible rail joint for steam-shovel tracks, described in our issue of Mar. 12, can be purchased. The joint illustrated herewith was invented by Walter J. Thull, and is manufactured by the Thull Rail Joint Co., 2248 West Superior St., Chicago, Ill. The device consists of



THE THULL RAIL JOINT IN SERVICE

two steel castings, bolted to and projecting beyond the rail end. Each casting is secured to its rail by a single bolt. The joint permits a certain amount of longitudinal flexibility.

An Efficiency of 79.8% for an engine-driven centrifugal pumping unit as been recorded by the Old River Rice Irrigation Co., Mont Belview, Texas. The plant of this concern contains two older units rope driven from tandem-compound engines besides the new unit tested which comprised a 40-in. double-suction centrifugal direct-connected to a cross-compound four-valve engine.

The average results of an 8-hr. run were as follows:

Steam pressure, lb. gage	145
Vacuum, in.	26.6
Speed, r.p.m.	193
Suction head, ft.	13.7
Discharge head, ft.	28.5
Total head, ft.	42.2
Discharge, cu.ft. per sec.	101.97
Discharge, gal. per min.	45,764
Water horsepower	488.78
Indicated horsepower	612.16
Combined efficiency engine and pump, per cent	79.85

The test was under the observation of S. G. L. Haas, R. M. Doherty and Frank Matthews, representing various parties involved. The pump was designed by A. B. Wood, of New Orleans, and built by the D'Olier Centrifugal Pump & Machine Co., Philadelphia. The engine was built by the Harrisburg Foundry & Machine Co., Harrisburg, Penn.

The City-Manager Plan of Municipal Government

By Paul E. Kressly*

The city manager is the latest innovation in the government of American municipalities, and strange to say, he is a direct indirect result of the Galveston hurricane. When fourteen years ago wind and wave conspired to wreck the Texas island city, the conditions created by the catastrophe demanded so much progressive and constructive work of the City Government that the old system of a board of aldermen and the usual string of independent elective officers broke down. A group of business men petitioned the state government to suspend the local government and replace it temporarily with a commission of five men. This was done, and the whole city was put under the control of these men, on a strictly business administration. The commission in a few days accomplished what a city council would have required months to do.

Des Moines, the Iowa capital, took up the idea, and improved upon it, and from that beginning the commission form of government has spread with surprising rapidity through the United States, and a peaceful revolution in four hundred cities has swept away the boards of aldermen, mayors and a host of minor officials and has set up new municipal governments on a plan so simple that the services of the "political boss" are not required to direct them.

The whole nation looks on with amazed enthusiasm, while the people in these towns not only get control over their government but keep it, election after election.

How and Why the Commission Plan Fails

The commission form of government has placed in the hands of the people an effective instrument of control; a governing organization which is continuously exposed to the full glare of public opinion, which really came from the voters, and which was sincerely anxious to obey them. While this form of government is a vast improvement over the form in general use up to seven or eight years ago, there is unquestionably room for still more improvement. In some of the cities it has proved very successful, while in others it has been a complete failure. This must not be regarded as a defect in the form of the government, but rather as due to the inefficiency of the members composing the commission. Take, for example, Wichita, Kan., where, as everywhere else, the commission plan was hailed five years ago as a "business plan" of city government which would settle all the difficulties under which the town had been laboring. Recently, the commission in this city has authorized the issue of $88,000 in five-year bonds to cover current deficiencies. After four years of the new rule, that does not look like good business. A little searching into the local situation reveals certain things which are directly or indirectly responsible for this condition.

One of the members of the Wichita commission is an ex-street laborer. Street work as a laborer is an honest calling, but does it give a man quite the preparation for managing one of the departments of a city as important as Wichita? There was doubtless excellent reason for electing him, for the labor people had an unquestionable right to select one of their men to represent them in a city's governing body. The man in question had a reputation for integrity and honesty, but even commission government has not made him a good business manager.

Here, then, is one trouble with the commission plan which the Wichita incident brought out in a graphic way: It is only by accident that you can secure five men who will be at the same time representatives of recognized divisions of the people and properly equipped for administrative service.

What, then, is the substantial and permanent contribution of commission government to the city problem? The one great thing it has done is to demonstrate beyond a shadow of a doubt the wisdom of giving over to a single elective governing body all the municipal powers. It has given the people a workable instrument, so far as general regulation is concerned, but it has failed to give the governing body the means with which to translate the general will of the people into detailed acts of government in the most effective way. A five-headed government carries with it the possibilities of friction, leads to inefficiency, which, in turn, leads to waste and even corruption. Furthermore, *municipal experts cannot be secured by popular election.*

The City Manager as Single Executive Officer

The city-manager plan does away with this five-headedness of municipal administration and substitutes a single head, not with advisory powers merely, but, subject to certain safeguards, with the powers of administrative "life and death," through actual control of appointments and removals.

The chief executive or city manager is not an elective officer, but is appointed by the council. He therefore does not divide responsibility with the council, but is subordinate to it. He need not be, at the time of his appointment, a resident of the city, but may be chosen from anywhere in the country. He is not chosen for a definite term, but holds office so long as he gives satisfaction to his superiors.

The controlled-executive plan filters everything through a group. It reduces the personal equation. Without loss of administrative unity, it abolishes one-man power. A single man may have his ups and downs, his freaks and fancies, his militant points and his passive ones, his natural bents and moods, his pet departments and projects. A board, or commission, or council, or parliament, has none of these things—to a group such excesses are relatively impossible. Even if all the members were cranks, their combined judgment would be reliable—they would neutralize each other.

This plan corresponds to the general manager under the board of directors in a business corporation. It gives the stability of the combined judgment of many men on matters of policy, but leaves execution to a single-headed controlled executive establishment.

For the highest efficiency we must put the chief administrative official, as well as subordinate officials of the same sort, on a professional basis. This means simply that we must leave his selection and his indefinite retention to some person or body that is in a position to examine his work closely and therefore judge of it intelligently, and that we must also take the matter out of politics, not by incessantly harping on the desirability of doing so, but by relieving him of all except purely administrative duties. That is not saying, you will notice,

*City Manager and City Engineer, Inglewood, Calif.

or even implying, that "the people cannot be trusted to choose" the chief administrator. It is implying merely that they are not in a position to do so to advantage, and that if the official in question is given the veto and other policy-determining functions, neither the people nor anybody else can be expected, no matter how well they realize the advantage of experience in administrative work, to do anything but oust him as often as his opinions are not in conformity with those of the majority.

We are confronted with the question: From what profession or calling shall this important position of city manager be filled? My answer is, that the city manager should be a civil engineer, with municipal-engineering experience; who should also possess the additional qualifications of an economist, a financier, and have executive ability.

What other profession has men who are better qualified as municipal experts than the engineering profession? Are not the members of the engineering profession, in the course of their education, field work and research work, peculiarly qualified for executive duty developed by their training and experience? Engineering is perhaps as much a matter of common sense as of education, and the engineer, to succeed, must have both. Therefore, a capacity to get at the facts in any case, supplemented by good judgment, are predominating traits, characterizing this profession more prominently as essentials than is the case with any other profession or calling.

The City Manager of Inglewood, Calif.

The board of trustees of the city of Inglewood followed the very rational plan of appointing their city engineer, the writer, as city manager, he having served the city in the capacity of city engineer for two years. In the ordinance passed by the board creating this new position, practically all of the executive and administrative powers of the trustees are delegated to the city manager, and they have given him their personal assurance of their loyalty in anything he might undertake to perfect the organization and place the affairs of the city on a business basis.

The ordinance was passed on Mar. 2, and legally did not take effect until 30 days thereafter, but the board deemed it necessary that I be appointed and assume the duties of city manager at once. This procedure naturally caught me unprepared. However, I made the best of the situation, and began immediately to formulate plans.

My ideals as a basis upon which to erect the superstructure of my organization were efficiency and economy. In order that my administration should be successful, I was compelled to strictly adhere to my ideals and, in consequence thereof, I was obliged to make quite a few changes in the organization of several departments. On account of having been city engineer, I was familiar in a general way with the weaknesses of the various departments, and in order that they be corrected, I determined that the requisites of all employees should be efficiency, economy, honesty and loyalty, and that employees who possessed these qualifications should be retained regardless of their political faith.

With the requisites thus set forth, a few dismissals were necessary, as this city, like many others, was not without political officeholders, who held positions regardless of their qualifications or fitness.

I will not attempt to describe the reasons for the dismissals, but I wish to state that if any of my fellow-engineers ever receive the appointment of a city-manager-ship, and they are obliged to dismiss employees, they need not be discouraged by threats and wild epithets being hurled at them by "political bosses," and their followers, since this is a natural procedure in the course of uncovering the "efficient" and "economical" work of their "pets." There is an erroneous impression grounded in the minds of so many municipal employees that they are not required to do as much work as for a private corporation; that they need not take any particular interest in the work; that working hours need not be observed; that they can take a leave of absence of a few hours every now and then, without consulting the head of the department, and at the same time be entitled to full wages; that they need not be courteous and accommodating to the public; that they can waste materials or supplies because the city pays for them. They labor under the pretext of the old political saying "to the victor belongs the spoils," and are therefore justly entitled to be given employment, and to do whatever they please, irrespective of the quality or quantity of the work performed, or of their value and worth to their employers, or interest taken in the business affairs of the city.

Specific Achievements at Inglewood

The following is a brief summary of some of the important movements undertaken and changes made in the various departments of Inglewood:

1. The removal of inefficient and incompetent men from the city service.
2. Requiring all employees to obtain an order, signed by the city manager, for the purchase of machinery, tools, supplies, materials, etc.
3. Accounting system installed and providing balance sheets of all accounts.
4. Limiting all city departments to a limited expenditure, and providing for an emergency fund, all within the actual revenues of the city.
5. Monthly detailed reports from each department.
6. Installation of unit-cost system, where practical in all departments.
7. Enlarging and defining the duties and powers of the Park Commission to exercise control and supervision of all parks and street tree planting, and of beautifying the street and avenue parkways by the formation of assessment districts to pay the costs and expenses thereof.
8. Arranged with electric light and telephone companies to have poles removed from streets and avenues into alleys.
9. An Ordinance prohibiting the trimming of street trees by property owners, and delegating these duties to the park commission, and prohibiting the destruction of shade or ornamental trees, shrubs and flowers, and providing penalties therefor.
10. A Resolution providing for the removal of weeds from street parkways, at the expense of the property owners.
11. Commission appointed to revise building ordinance.
12. Commission, composed of five members, one each from Grammar School Trustees, School Teachers, Parent-Teachers Association, Women's Club and City Manager, to arrange for the improvement and beautification of school grounds.
13. Providing more convenient and enlarged quarters for the Public Library.
14. Establishing more stringent rules and regulations governing the care of buildings and apparatus in the Fire Department.
15. Increased the efficiency of the Building, Plumbing and Electrical Inspectors Department, and placed it on a revenue-producing basis.
16. Motorcycle officers ordered to strictly enforce ordinances pertaining to speeding on boulevards, and prohibiting heavy hauling on certain avenues.

17. Arrangement made with Fire Engineer to coöperate with City Marshal' department to receive calls for his department, thereby greatly increasing the efficiency of the Police Department.
18. Consolidating the City Engineer's and Street Superintendent's office, which heretofore were entirely separated; the City Engineer having had charge of all new improvements, while the Street Superintendent had charge of the maintenance and repairs.

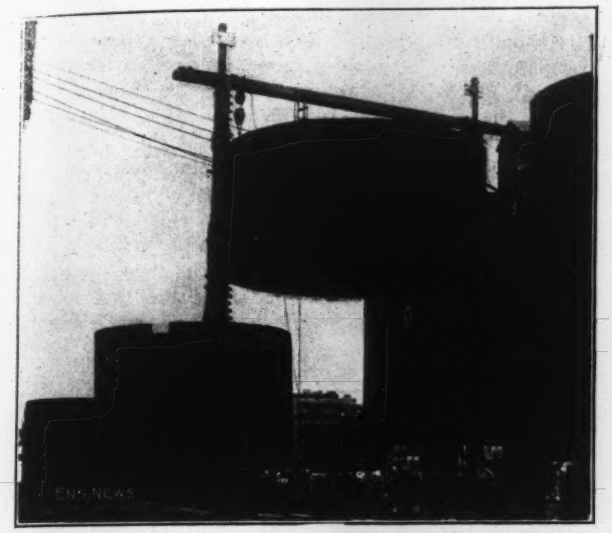


FIG. 1. MOVING LARGE STEEL GRAIN TANKS AT CHICAGO

(Each tank is cut in two. The upper part is raised by the gallows frame while the lower part is moved out on rollers. Then the upper part is lowered and moved out in the same way.)

19. The removal of incompetent, inexperienced men from the service of the street department, and placing competent, experienced and able-bodied young men in their places, reducing the force to half the number.
20. Systematizing the work of the Street Repair and Maintenance Department, and establishing a unit-cost system for the various classes of street work.
21. Provision for a material supply yard adjacent to Railroad, and the housing of roller, graders and other implements.
22. Movement under way to require all public-utility corporations to take out permits for all street excavations, and requiring a deposit with street superintendent, an amount sufficient to cover the expense of replacing street surfaces to the original condition. Said work to be performed by the street superintendent.
23. The collection of rubbish and garbage.
24. Placing of receptacles for paper, rubbish, etc., along the principal streets of the city.
25. Effected the coöperation of the Police Department with the Health Department in enforcing quarantine ordinances and the strict enforcement of all ordinances pertaining to the health of the citizens and cleanliness of premises.
26. Compelling all employees to observe the following working hours; 8 a.m. to 12 m. and from 1 to 5 p.m.
27. Permission must be obtained from the heads of department before any employee is permitted to leave his regular duties.
28. Requiring an inventory of all office furniture, fixtures, supplies, machinery, tools, material, etc., to be submitted to the city manager.

The ordinance creating the city managership in Inglewood, defines his duties and powers, and gives him authority to exercise control over all departments, but expressly excepts the legal department from the operation of the ordinance. In my opinion, based upon past experiences, this is a serious defect. The city attorney should be under the control of the manager, because there is not a single department in any city which causes more delays in public-improvement proceedings than the legal department. These delays are a handicap to the engineering department, oftentimes proving to be an additional expense, which could have been avoided if the city manager exercised control of that department.

Moving Large Steel Grain Tanks

The moving of large steel storage tanks a distance of about five miles is interesting work in connection with the removal of the Albert Dickinson Co., seed merchants, of Chicago, to a new plant at Washtenaw Ave. and 35th St. near the Drainage Canal. The old plant was at Taylor St. and the Chicago River, but the site is being cleared for the new terminal work of the Pennsylvania Lines. The equipment included 22 steel storage tanks 60 and 40 ft. high and 30 and 40 ft. in diameter, weighing 40 to 50 tons each. As these were in good condition it was desired to move them to the new plant. The tanks are covered with conical tops supported on light radial trusses.

The method adopted was as follows: A timber gallows frame was built, large enough to straddle a 60-ft. tank, and having two sets of hoisting tackle on the crossbeam. This was set up over a tank, and the hoisting hooks attached to two sling plates bolted to the top of the tank, as shown in Fig. 1. The rivets of the middle circular seam were then cut out by hand, and the upper half of the tank was lifted by the tackle. Then the lower half was raised by jacks sufficiently to allow of placing under it four heavy timbers, with blocking and wedges to support it at various points. Under this supporting frame were

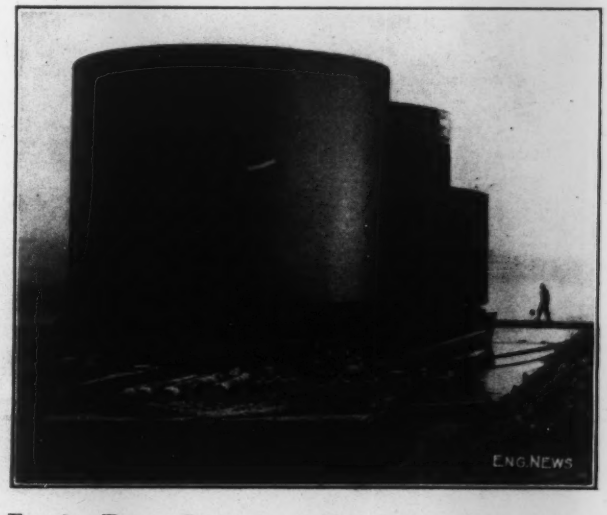


FIG. 2. THREE SECTIONS OF TANKS ON A SCOW, READY FOR UNLOADING AT THE NEW SITE

two lines of timbers with planking, forming roller runways for the wooden rollers used in moving buildings.

The lower section of the tank was then hauled out by a hoisting engine, the block of the hauling rope being hooked to a bridle attached to the two side timbers of the supporting frame. A similar frame was then built and the upper section of the tank lowered upon it. These frames remained under the tanks throughout their removal. Each section of tank was held in shape by an interior frame of four timbers, with blocking between these

and the tank shell; there were also interior ties of wire cable attached to threaded rods which passed through rivet holes and were secured by nuts.

A double-track roller runway was built through the yard to the river bank, and the tank sections hauled on this and onto a large deck scow, the scow holding three sections, as shown in Fig. 2. The scow was then towed down the river and the Drainage Canal to a point near the new plant. A roller runway, supported on piers of blocking, was extended from the deck to the bank, and the tanks were hauled off by a horse winch. The final disposition has not been decided. They may be erected on a site adjacent to the canal, or they may be moved to the site occupied by the rest of the plant. In the latter case, they will have to be raised and transferred across two railway embankments and a small canal.

This work was undertaken by the John Eichleay, Jr., Co., of Pittsburgh, Penn., which makes a specialty of moving houses and other structures. They state that the tanks could have been moved without cutting them apart but for the large number of electric wires and cables strung along the drainage canal. The river trip was somewhat slow, as there were 17 bridges to pass (including a four-track bascule bridge with each section operated independently). The Western Ave. swing bridge over the canal has no operating machinery, and had to be operated by the tugs, which cast loose the scow and hitched their two lines to chains hanging from the ends of the adjoining bridge.

A Hydraulic Sand-Mining Plant

By R. A. Boehringer*

Between Lewistown, Penn., on the east and Huntingdon on the west, the Juniata River cuts through several limestone ridges, which run approximately north and south. These ridges, between the Blue Mountains on the east and the Allegheny Mountains on the west, consist mainly of silicon dioxide, which finds extensive application in the manufacture of glass of all kinds, fine plaster, crucible steel, fire brick, by railways for use on slippery rails, and in the purification and filtration of chemicals and water.

The ridges occur in the form of sand rock, which is both quarried and mined by a number of different companies for the manufacture of sand. The total output of commercial sand from the companies in this locality is about 1500 tons daily. The largest of these companies is the Pennsylvania Glass Sand Co., and this concern has installed a hydraulic sand plant near Vineyard, Penn., which is unique in this part of the country.

The buildings of the new works are located at the foot of a steep hill, with the quarry about 100 ft. vertically above. Across a small ravine above the quarry a masonry and concrete dam has been built, forming a reservoir of 500,000 gal. capacity, which distributes water to the

*Division Engineer, Water Supply Commission of Pennsylvania, Harrisburg, Penn.

General View of Hydraulic Land Mining Plant, Vineyard, Penn.

(Taken from the foot of the quarry and showing the plant, the main line of the Pennsylvania R.R. and the Juniata River. (A) is the trough for collecting the sand and water; (B) is the first revolving screen through which the sand passes before entering the reduction house; (C) is the car used for moving the blocks of silica from the quarry to the reduction house, where the sand is crushed, screened and washed out. The structure in framework is the drain and dry building.)

monitor, the quarry, the sand-washing machines and the boilers.

In the operation of the quarry, the general method of procedure at first was to use the hydraulic process when there was sufficient soft material encountered, and to blast the rock when the stream from the monitor was unable to supply sand to the washing machines. In this way it was found that about 50% of the average daily output of 125 tons of sand could be produced hydraulically. Later experience has shown that except where it is necessary to loosen ledges of the harder rock with dynamite, blasting is no longer required, and it has been superseded by the hydraulic method.

A 6-in. pipe is laid to the middle of the quarry floor, to which a 6 to 7/8-in. monitor is attached. The monitor is detachable, so that it will not be injured when blasting. The monitor plays upon the face and floor of the quarry, loosening and bringing large blocks of rock to the floor, and washing the loose sand and small stones into the opening of a trough at the lower end of the quarry, toward which the floor slopes.

On account of the trouble in fastening and unfastening the monitor, a 2½-in. fire hose with a ¾-in. nozzle is now used most of the time, and is fastened on taps on the pipe line which encircles the quarry. With one man at the hose and one to keep the troughs clear, they can deliver to the reduction house from 25 to 40 tons of sand per hour. An exploration drift shows that the material becomes better and is more easily mined hydraulically as the hillside is washed back farther.

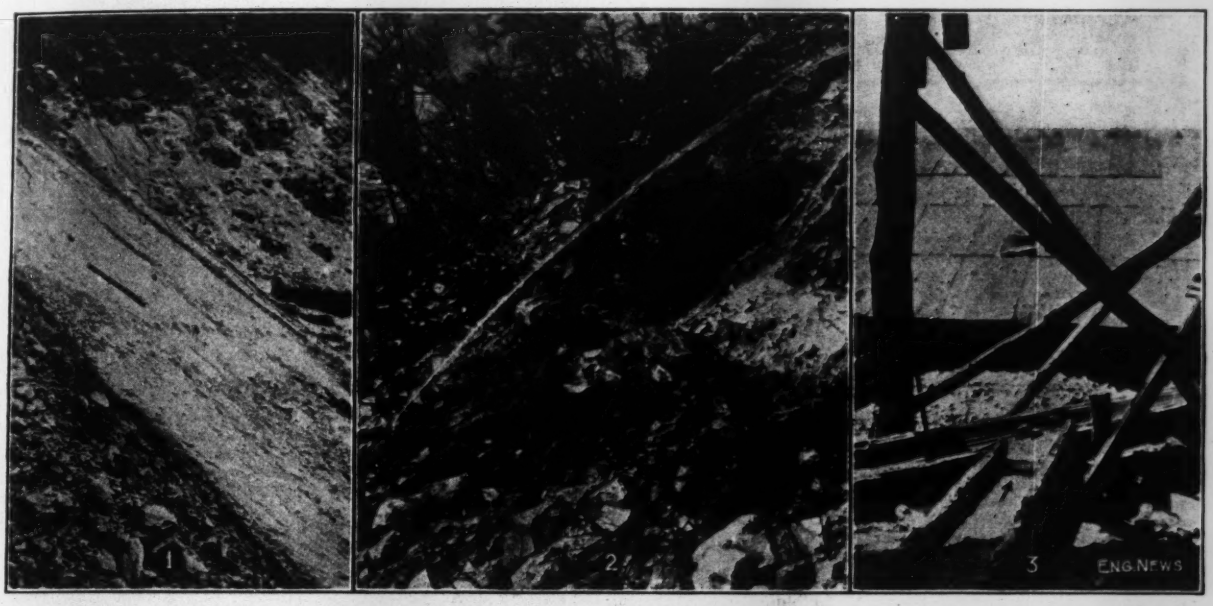
The sand and water are carried in a 10x12-in. flume 50 ft. to the reduction house, where it enters a revolving screen. This is a double screen, with a ½-in. mesh on the inside and a 12-in. mesh of No. 20 wire on the outside. The function of the inside screen is to receive the raw material, screen out the sticks and twigs which come from the thick forest cover of the quarry, and to take out the small stones, which are wasted. This waste, however, amounts to very little.

From the revolving screen the sand is shot through a short trough direct to the washing machines. These machines consist of an inclined box with four alternating screws and troughs. The sand comes from the revolving screen into one end of the washing machine. A screw, working in the machine, carries the wet sand to the top of the inclined box, where a jet of water plays on the sand, washing it down a trough, beside and parallel to the screw, to the bottom of the box. Here a second screw carries the wet sand to the top of the box, where a second jet washes the sand down a second trough to the bottom of the box. This operation is repeated in the third screw and trough, after which a fourth screw carries the clean sand to the top of the inclined washer, where the sand is dropped off on a belt conveyor and carried to huge piles, where the water is allowed to drain off before shipping the sand.

The large blocks of rock in the quarry are blasted and broken up, loaded into dump cars on narrow-gage tracks, and pushed by the quarrymen to a rock crusher in the reduction house. Leaving the rock crusher, the stone is further ground up in a revolving mill, from which it passes into a revolving screen. From the screen, stones which escaped crushing are returned to the grinding mill, while the sand drops into washers similar to those which clean that brought to the reduction house by the hydraulic process.

After the crusher sand leaves the washers, it is carried by a belt conveyor, working on V-shaped rollers, to the drain and dry building, where it is dumped into great piles, where the water is permitted to drain off. When the sand is dropped from the conveyors, it contains from 25 to 28% of water; after standing 48 hours, it still contains about 12%.

The drain and dry house has a storage capacity of 3600 to 3800 tons of sand. The storage space occupies the middle and one side of the building, while the other side is occupied by the dryers. The latter consist of a brick prism filled with steam pipes. The top is open to



FIGS. 1 AND 2. TYPICAL PARTS OF QUARRY FACE

FIG. 3. FLUME TO PLANT

receive the wet sand, while the bottom is V shaped, with a belt-conveyor traversing the length of the dryer at the bottom of the open V.

Between the storage space and the dryer is a concrete wall on which a traveling bucket-conveyor is mounted to take the sand from the drain piles to the dryers. The buckets are loaded by hand, and with the exception of the work done in the quarry and in placing the finished sand in box cars, this is the only place where the sand is handled. In the drain and dry building, however, provision has been made for the future installation of a traveling crane operating a grab bucket, which will be used in moving the wet sand from the piles into the dryers.

From the dryers the sand will be carried by a belt and a bucket conveyor to a 20-mesh screen near the top of a 73-ft. tower, where the pebbles are separated from the fine sand. From this screen the finished product will be carried by a short bucket conveyor to large bins in the top of the tower, from which it can be shot straight down into cars on a side track below.

NEWS NOTES

A Covered Wooden Bridge Burned on the Schuylkill & Lehigh division of the Philadelphia & Reading Ry., near Kempton, on July 30.

Two Houses Collapsed—Undermining from an adjoining cellar excavation caused a house, in Toronto, Ont., to collapse, on July 23.

A house in Evansville, Ind., collapsed, on July 28, while being wrecked.

A Derrick Car Turned Over on the western viaduct approach of the Hell Gate Bridge of the New York Connecting Railway, at E. 132d St., the Bronx, on Aug. 1, killing one man. The derrick was used for erecting steelwork. Its capacity was 100 tons.

The Supports of an Old Timber Bridge Failed at Branford, Conn., on July 29, under the weight of a cartload of logs. Although the bridge settled, the flooring was firm enough to permit the cart to proceed safely to the road beyond. A number of boys sitting on the rail, fishing, were uninjured.

A Timber Bridge Collapsed under the weight of a wagon-load of lumber, at Independence, Kan., on July 23, injuring the driver. The height of the bridge was about 15 ft.

On July 25, near Wichita, Kan., a county bridge over the Cowskin River fell under the weight of a milk wagon. The bridge was about 80 ft. long.

A Disastrous Wreck Occurred at Tipton Ford, Mo., on Aug. 5, when a Kansas City Southern Ry. passenger train and a gasoline motor car met in a butting collision; 40 were killed and about the same number injured. Press dispatches state that the car had orders to wait at a point south of Tipton Ford, but the orders were unheeded. In the collision, gasoline from the tank of the car was scattered about the débris and upon the clothing of the imprisoned passengers. The wreckage caught fire.

Another Timber Pier Fire—On July 30 fire destroyed the Grand Trunk Pacific pier and seriously damaged the adjoining Coleman pier in the port of Seattle, Wash. The Grand Trunk pier was 594 ft. long by 125 ft. wide and founded on creosoted piles. It had a two-story shed containing a great deal of unnecessary ornamental work of inflammable material, many partitions and a large amount of space used for offices. There were no fire walls under the floor nor in the first 530 ft. from the pier head. There were no draft curtains in the roof trusses and no sprinkling system. The structure was comparatively new, but a very poor fire risk, and it burned quite rapidly. Fortunately there was no wind, otherwise the disaster would have been much greater. As it was the pier was practically destroyed and the Coleman pier next south was considerably damaged but not enough to stop business. In addition to the property loss, which is estimated at $500,000, one man was killed and eight persons were injured. Included in the fire damage is the damage to stored freight, which was in the warehouse. The Pacific Alaska Navigation Company's steamship "Admiral Sampson" was lying alongside the Grand Trunk pier waiting to sail for San Francisco when the fire started. The liner, which had all her cargo and most of her baggage aboard, cast loose and escaped damage. The fire started near the river end of the pier and spread toward the shore. As is common in pier fires it was most difficult to fight.

From Gen. H. M. Chittenden, Port Commissioner of Seattle, we have had the following word:

"The present slips are altogether too narrow and business has been seriously handicapped on that account. Although it is rumored that the Grand Trunk Pacific is to rebuild its pier in concrete, what should be done is that the port district should take over the Grand Trunk and the Coleman piers and rebuild as one pier, thus doing away with the narrow intermediate slip. It is quite possible, however, that the city will hesitate on account of the heavy cost. The new port district wharves are of timber, sprinkler protected, with the warehouses and other structures of concrete. With proper fire measures and reasonable precautions such structures need not be so dangerous as is commonly supposed. Whether in a particular case the fire risk justifies the heavy extra cost of concrete work must be decided by the circumstances. Certainly no hard and fast rule is possible, and there is no justification of unnecessary financial sacrifice simply to meet more effectually one feature of construction and use."

The Pathfinder Reservoir of the North Platte Project (Nebraska-Wyoming) of the United States Reclamation Service was filled for the first time in June, 1914. On June 27 the storage amounted to about 1,085,000 acre-feet and water to a depth of 0.9 ft. was running over the spillway.

Water Deferrisation and Demanganation at Lowell, Mass., in accordance with the scheme outlined in our issue of July 9, 1914 (p. 107), has been authorized by the city council. An appropriation of $190,000 for the work has been made. Robert J. Thomas is Superintendent of Water-Works at Lowell.

The "Adamson Bill" amending the "General Dam Act" of Congress (as approved June 21, 1906, and amended June 23, 1910) passed the House, Aug. 4. It was read twice in the Senate, Aug. 5, and referred to the Committee on Commerce. This is the administration measure to facilitate and regulate the development of water power on navigable streams.

The Snoqualmie Tunnel of the Chicago, Milwaukee & St. Paul Ry. through the Cascade Mountains was holed through on Aug. 4. The tunnel ranks among the very long railway tunnels in the United States, having a total length of about 12,000 ft. It reduces the summit level of the line crossing the range 443 ft., saving also 4 miles in distance, while the line which will be abandoned was subject to heavy snow-slides.

Freight Transportation on an Inland Waterway Route is being developed by the Chicago, St. Louis & Gulf Transportation Co. on the Illinois & Michigan Canal, delivering freight from Chicago and vicinity to points on the Illinois and Mississippi Rivers. In order to bring freight to the waterway its promoters have made surveys for a terminal railway from La Salle, Ill., to Oglesby, connecting a number of large cement plants and manufacturing establishments. An interurban railway from La Salle to Sterling, Ill., is also proposed.

Commercial Opening of Panama Canal—The Secretary of War has announced that the Panama Canal will be opened to traffic on Saturday, Aug. 15, to vessels drawing not to exceed 30 ft. of water. This stipulation is made because of the conditions at Cucaracha slide, which, although greatly improved, would not admit of the passage of vessels with absolute safety drawing a greater depth of water. This restriction, however, probably does not affect any vessel now using the Panama route regularly, either in the Atlantic or Pacific.—"The Canal Record."

Use of Streets for Construction Purposes—The blocking of a street adjacent to a building under construction, by the storage of construction materials, etc., was prohibited by ordinance in Houston, Tex., on July 29. It is now required that the contractor secure from the city engineer a permit for the use of a portion of the street. Only one-third the width can be used on only one adjoining street, to be designated by the city engineer. As soon as the building material can be placed inside the new structure, the city engineer has the right to revoke the permit. The penalty for violation is a fine of not less than $25 nor more than $200; conviction will forfeit the right to obtain permits thereafter.

A **Railway Tunnel** five miles in length under the Jura Mountain range in Northern Switzerland was holed through on July 10. The work of construction is described in "The Engineer," London, of July 24. The tunnel is located about two miles south of Basel, on the German frontier of Switzerland. The old line from Basel south to Olten, which also has a tunnel about 1½ mi. long, has long grades of 2.6% and a much higher summit level than the new line built to pass through the new 5-mi. tunnel. The new tunnel is built for double track and is lined throughout, concrete having been used in most places. Work upon the tunnel was begun Feb. 1, 1912, and the contract date for completion was Jan. 13, 1915. The contract price was £792,709, with a bonus of $60 a day for each day's advance in the completion of the work.

Applications for the City Managership of Bristol, Va., are wanted. The facts in the case are thus stated in a letter to this journal, written by John H. Gose, City Clerk.

The city of Bristol, Va., is considering the employment of a competent man, with experience in engineering, to act under the supervision of the City Council as Executive Manager for the city, to perform the duties of street and water commissioner, have charge of all construction and repair work, the employment of all labor in these departments, and to purchase all supplies and material under the supervision of the Purchasing Committee of the Council. Salary per month will likely be fixed at $125 or upward. Applicants will please state age, ability to handle labor and an outline of the various positions held and the length of time in each, as far as practicable, and furnish such recommendations as they may desire. Also state salary expected.

Applications for the position should be addressed to John H. Gose, City Clerk, Bristol, Va.

Statistics of the World's Merchant Marine, made public by the Department of Commerce on Aug. 8, are of special interest in view of the probability that the European war will compel the United States to embark largely in ocean shipping. The merchant ships of the world aggregate 47,000,000 gross tons, of which 40% belong to Great Britain, 11% to the United States, 11% to Germany, 5% each to Norway and France, 3% each to Holland, Italy and Japan. While the United States is second only to Great Britain in volume of shipping, the great bulk of its ships are engaged in the lake and coasting trade, the total so engaged being 9,800,000 tons, while our total shipping in foreign trade is only 1,027,000 tons. It is of interest to note further that while the total capacity of the world's merchant shipping has doubled in the past twenty years, the number of vessels employed is about the same as twenty years ago, indicating that the average tonnage of merchant vessels has doubled in that time.

A New Steel Bridge with Concrete Floor Was Moved late position recently, on the Lehigh Valley R. R. at Wende, N. Y. (Erie County), replacing a lighter structure. The work was quickly performed. F. E. Schall, Bridge Engineer of the railroad, provides the following data:

The bridge is a double-track deck plate-girder bridge 98 ft. long, consisting of four girders, reinforced-concrete floor, waterproofing, brick waterproofing protection, stone ballast and track. The reinforced-concrete floor is supported upon I-beam cross girders resting on top of the plate girders, each track separate.

The new bridge was erected to the north of the old bridge, all complete, including the steelwork, concrete floor, ballast and track. After the proper seasoning of the concrete, the girders between the two tracks were blocked to form a unit laterally, for movement.

The tracks were cut and the old bridge rolled southward on timber bents; then the new bridge was rolled into position, both tracks simultaneously.

The weight of the steelwork including reinforcement steel is 521,000 lb., the weight of the concrete, waterproofing and protection, stone ballast and track is about 850,000 lb., a total of 1,371,000 lb. or 685½ net tons.

The Largest Diesel Oil Engine yet built in America is said to be one just shipped by the Lyons Atlas Co. of Indianapolis. It is rated at 600 b.hp. with an overload capacity of 15% with an 890-b.hp. maximum. It is a vertical four-stroke cycle engine with cylinders 21x30 in. and has been shipped to the Hawaiian Commercial & Sugar Co. to supersede a steam plant for pumping water for irrigation. The engine is direct-connected to a two-stage turbine pump capable of delivering 15,000,000 gal. of water per day under 200-ft. head. The builders have furnished the following statement as to the conditions under which the engine was built and the tests to which it was subjected:

"The purchaser required that the engine should operate continuously 710 hours out of each 720 hours per month at rated load, using the ordinary 14% to 18% asphaltum-base California fuel oil, similar to that used in the purchaser's steam plant, and which is the only grade available on the islands.

"The test was conducted by the chief engineer of the Hawaiian Commercial & Sugar Co., and the engine was given a preliminary, continuous run of 48 hours with eastern paraffin-base fuel after which all parts connected with the combustion chambers were inspected in order to determine a basis for comparison between the effect of the two fuels. It was then subjected to a 144-hour continuous run at full load with fuel shipped by the purchaser from California to the manufacturer's works. At the completion of this run the combustion chambers were again examined, and as there was no evidence of deposit on the heads, valves or pistons, the engine was accepted and is now en route to the islands, to be erected by their own engineers without any assistance from the manufacturer."

A Report to the Dayton Flood Prevention Committee, of Dayton, Ohio, has been published. The report was made by a Special Board of Consulting Engineers of eight members, and approves the plans for the proposed Miami Conservancy District made by the Morgan Engineering Co., of Memphis, Tenn., and Dayton, Ohio. The original intention was to submit the report to the Conservancy Court created to pass on the petition for the establishment of the proposed district, but litigation having postponed the hearing indefinitely, it was decided to publish the report without further delay.

The eight members of the Special Board of Consulting Engineers were: Gen. O. H. Ernst, Washington, D. C.; J. A. Ockerson, St. Louis, Mo.; Gen. H. M. Chittenden, Seattle, Wash.; T. W. Jaycox, Denver, Colo.; J. H. Fuertes, New York City; W. A. O'Brien, Cape Girardeau, Mo.; Charles H. Miller, Little Rock, Ark.; and Morris Knowles, Pittsburgh, Penn. The report is 20 printed pages in length. It reviews briefly flood conditions in the Great Miami Valley in general and the 1913 flood in particular, and considers possible remedial measures. The Board concluded that protection by channel improvement for the entire river would cost about $100,000,000 against $18,000,000-$20,000,000 for detention basins and limited channel improvements, and that the maintenance cost would be correspondingly heavy and light, respectively. The final opinion of the board was as follows:

(1) That floods as great as that of 1913, and even greater, are liable to occur at any time, and preventive measures should be carried out which will control floods about 20% greater than that of 1913.

(2) That permanent flood protection for the Miami Valley by means of channel enlargement alone is impracticable.

(3) That detention basins, supplemented by limited channel improvement, do offer a satisfactory solution of the problem.

(4) That the success of such plan for flood control requires that the flooded area of the Miami Valley above the Whitewater River be considered as a unit.

(5) That the works of the type suggested, properly designed, located, and constructed, will not only provide satisfactory and economical protection from floods, but they will be so massive and substantial as to fully justify confidence in their integrity, and satisfy every reasonable question of stability.

It may be added that the plans here passed upon were made under the immediate direction of Arthur E. Morgan, of the Morgan Engineering Co., with the advice of the following consulting board: John W. Alvord, of Chicago; Prof. Daniel W. Mead, of Madison, Wis., and Chicago, and Prof. S. M. Woodward, of Iowa City, Iowa.

PERSONALS

Mr. R. A. Baldwin has been appointed Engineer of Maintenance-of-way of the Ontario grand division of the Canadian Northern Ry., Eastern lines, with headquarters at Toronto, Ont.

Mr. Jesse K. Giesey, Assoc. M. Am. Soc. C. E., Assistant Engineer of Hering & Gregory, Consulting Engineers, New York City, has resigned to take charge of sewer work in York, Penn.

Mr. E. C. Deal has been appointed Vice-President and Chief Engineer of the Carolina & Yadkin River Ry., with headquarters at Greensboro, N. C., succeeding Mr. J. P. Clark, resigned.

Mr. William A. Hansell, Jr., M. Am. Soc. C. E., formerly with the city engineering department of Atlanta, Ga., has been elected Superintendent of Public Works of Fulton County, Ga.

Mr. J. D. Evans, formerly Chief Engineer of the Central Ontario Ry., at Trenton, Ont., has been appointed Division Engineer of the Ottawa division of the Canadian Northern Ry., with headquarters at Ottawa, Ont.

Mr. G. F. Stickney, M. Am. Soc. C. E., Supervising Engineer

of the New York State Barge Canal, Albany, N. Y., has been granted leave of absence to go to Pittsburgh, Penn., to make the preliminary estimates and plans for the Ohio & Lake Erie Canal. The work will take about three months.

Mr. Arthur F. Ballou has resigned as Superintendent of the Providence, R. I., Water-Works Department, to become associated with the National Board of Fire Underwriters. He is succeeded as Superintendent by Mr. Carleton Scott, Assistant Engineer, City Engineer's Office of Providence.

Mr. William J. Hazeltine has been appointed City Engineer of Mansfield, Ohio, succeeding Mr. Emmet Merkel, resigned. Mr. Hazeltine is an engineering graduate of the Ohio Northern University, class of 1911, and has had some street and road experience in New York and New Jersey.

Mr. W. C. Schade has been appointed General Manager of the Phoenix Iron Works Co., Meadville, Penn., effective Aug. 15. Mr. Schade resigned as President of the Cherry Tree Iron Co., Cherry Tree, Penn., last February, but his resignation was not accepted owing to the inability of the company to find a suitable successor.

Mr. Charles O. Tappen has resigned as Chief Engineer of the Northern Power Co. and the Hannawa Falls Water Power Co., Potsdam, N. Y., and has opened an office as Consulting and Constructing Engineer, 2 Rector St., New York City, specializing in hydro-electric power, transmission, public utilities engineering, valuation and appraisal work.

General Joseph Joffre, Commander-in-Chief of the French Army in the present European War, is a notable civil engineer. He is a graduate of the École Polytechnique, Paris, France. He saw much of his early service with the engineer corps and has had charge of railway construction in West Africa and harbor work in Madagascar.

Mr. Othmar Hermann Ammann, M. Am. Soc. C. E., Assistant Chief Engineer of the New York Connecting R.R., which is building the Hell Gate steel arch bridge, is among the foreign army reserve officers who have been called back to their native countries. Mr. Ammann is a reserve officer in the Swiss Army and has returned to Switzerland to offer his services.

Lord Horatio Herbert Kitchener, the new head of the English War Office, is an engineer by education and experience, as well as a soldier. Lord Kitchener is a graduate of the Royal Military Academy at Woolwich, and entered the Royal Engineers in 1871. Between 1874 to 1882 he had charge of extensive survey work in Palestine and the Island of Cyprus. For several years he was head of the Royal Engineers.

Mr. A. J. Hills, former Superintendent of the Canadian Northern Ry., at Toronto, Ont., has been promoted to be General Superintendent of the Ontario grand division of the Canadian Northern Ry., Eastern lines, in charge of operation, maintenance-of-way and motive power, with headquarters at Toronto, Ont. Mr. Hills is an engineering graduate of the University of Toronto, and for several years following his graduation in 1899 he was with the construction department of the Canadian Northern Ry. at Winnipeg, Man.

Mr. Frederic A. Delano, M. Am. Soc. C. E., former President of the Wabash R.R., now President of the Chicago, Indianapolis & Louisville Ry., has been appointed a member of the Federal Reserve Board. Mr. Delano is also a member of the Government Commission on Industrial Relations, to which he was appointed by President Taft. He takes the place on the Federal Reserve Board made vacant by the retirement of Mr. Thomas D. Jones. Mr. Delano is a well known writer on railway and transportation problems, and is a civil and mechanical engineer of many years' experience. He was born in Hong Kong, China, in 1863, but spent most of his boyhood years at Newburgh, N. Y., where he prepared for Harvard College. Mr. Delano graduated at Harvard in 1885, and the following summer joined a survey party of the Chicago, Burlington & Quincy R.R. in Colorado. In the fall of that year he became a machinist apprentice of the same railway at Aurora, Ill. Two years later he was placed in charge of the bureau of steel rail inspection tests and records. After a year as Assistant to the Second Vice-President, he was appointed Superintendent of Freight Terminals at Chicago, Ill., where he remained for nine years. Later he was Superintendent of Motive Power, and, from 1901 to 1905, was General Manager. For a few weeks in 1905 he was Consulting Engineer to the United States War Department and the Philippine Commission, after which he returned to the railway service as Vice-President of the Wabash R.R. He was elected President in 1905; later he was Receiver. He was elected President of the Chicago, Indianapolis & Louisville Ry. in the latter part of 1913. Regarding his recent nomination to the Federal Reserve Board, Mr. Delano is quoted by a New York "Times" correspondent as follows:

> If President Wilson should nominate me, and my nomination were confirmed by the Senate without question, I should feel it my duty to accept. I neither want the place nor have I sought it, and I certainly could not take it if my record were not such as to warrant my confirmation without a personal examination. But if I am appointed without any solicitation on my part, I shall accept, as I believe it would be my duty to do so.

OBITUARY

William Barstow Strong, former President of the Atchison, Topeka & Santa Fé Ry., died Aug. 3. He was born in Vermont in 1837.

ENGINEERING SOCIETIES

COMING MEETINGS

AMERICAN ASSOCIATION OF RAILROAD SUPERINTENDENTS.
Aug. 20-21. Annual meeting in New York City. Secy., E. H. Harman, Room 101, Union Station, St. Louis, Mo.

AMERICAN PEAT SOCIETY.
Aug. 20-22. Annual meeting at Duluth, Minn. Secy., Julius Bordollo, 17 Battery Place, New York City.

AMERICAN BOILER MANUFACTURERS' ASSOCIATION.
Sept. 1-4. Annual convention in New York City. Secy., J. D. Farasey, E. 37th St., and Erie Ry., Cleveland, Ohio.

AMERICAN MINE SAFETY ASSOCIATION.
Sept. 7-10. Annual meeting in New York City. Secy., H M. Wilson, Bureau of Mines, Pittsburgh, Penn.

AMERICAN FOUNDRYMEN'S ASSOCIATION.
Sept. 7-11. Annual meeting at Chicago, Ill. Secy., A. P. Backert, Cleveland, Ohio.

NATIONAL PAVING BRICK MANUFACTURERS' ASSOCIATION.
Sept. 9-11. Annual convention at Buffalo, N. Y. Secy., Will P. Blair, 832 B. of L. E. building, Cleveland, Ohio.

NATIONAL ASSOCIATION OF PORT AUTHORITIES.
Sept. 8-10. Annual convention in Baltimore, Md. Secy., Wm. Joshua Barney, 29 Broadway, New York City.

ROADMASTERS AND MAINTENANCE OF WAY ASSOCIATION OF AMERICA.
Sept. 8-11. Annual meeting at Chicago, Ill. Secy., L. C. Ryan, Sterling, Ill.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION.
Sept. 8-11. Annual convention in Nashville, Tenn. Secy., A. P. Dane, Reading, Mass.

NEW ENGLAND WATER-WORKS ASSOCIATION.
Sept. 9-11. Annual convention in Boston, Mass. Secy., Willard Kent, Narragansett Pier, R. I.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.
Sept. 15-18. Convention in Atlantic City, N. J. Secy., Clayton W. Pike, Electrical Bureau, Philadelphia, Penn.

ILLUMINATING ENGINEERING SOCIETY.
Sept. 21-25. Annual convention in Cleveland, Ohio. Secy., Joseph D. Israel, 29 W. 39th St., New York City.

RAILWAY SIGNAL ASSOCIATION.
Sept. 22-24. Annual convention in Bluff Point, N. Y. Secy., C. C. Rosenberg, Times Building, Bethlehem, Penn.

American Society of Agricultural Engineers—The annual meeting of the Society will be held in Madison, Wis., Dec. 28-30. The preliminary program has just been issued. The Secretary is F. M. White, Madison, Wis.

American Road Congress—The Fourth American Road Congress will be held at Atlanta during the week of Nov. 9. State Highway Engineer Fletcher, of California, has been elected president, and will preside at the opening session. One of the subjects for discussion is "Systematic Road Management," involving the organization of working forces and the methods of reporting and recording work. This subject will be presented by Hon. Chas. J. Bennett, State Highway Commissioner of Connecticut. State Highway Engineer Keller, of Alabama, will deal with the subject of "Engineering Supervision.' Among the various phases of construction and maintenance of all types of roads, the construction known as the sand-oil method, involving the use of a mixture of asphaltic oil and sand, will be thoroughly discussed. This type of road is in use in the Cape Cod region of Massachusetts and in the vicinity of Palm Beach, Fla. Fairfax Harrison, president of the Southern Ry., is scheduled to speak on the relation between the railroads and the wagon roads. The present headquarters of the Congress is in the offices of the American Highway Association, Colorado Building, Washington, D. C.